Appendix D

Standard Operating Procedures

(Compact Disc)

SOP-01

Environmental Sample Handling

Yerington Mine Site
Standard Operating Procedure

Revision 1
Revision Date: May 5, 2008

SOP-01
ENVIRONMENTAL SAMPLE HANDLING

TABLE OF CONTENTS

1.0 OBJECTIVE

The objective of this procedure is to establish a uniform method for the handling of environmental samples. This includes the procurement of the appropriate sample containers and preservatives, chain of custody procedures and the use of appropriate sample shipment methods.

2.0 SCOPE AND APPLICABILITY

This procedure will be used during the collection of all types of environmental media that include, but are not limited to, groundwater, surface water and soil. Handling of air samples is not addressed in the current version of this procedure.

3.0 RESPONSIBILITIES

The *Project Manager (PM),* or designee, will have the responsibility to oversee and ensure that the handling of samples is in accordance with this SOP and any site-specific or project specific planning documents.

The *field sampling personnel* will be responsible for the understanding and implementation of this SOP during all field activities, as well as, obtaining the appropriate field logbooks, forms, and records necessary to complete the field activities. Field personnel will ensure all field activities are documented completely at the end of each field day. Field personnel are responsible for assuring that the original documentation (or copies of the field log book, if needed for another project at the same site), are filed at the end of the field project, or during a long project (greater than a month) every couple of weeks.

4.0 DEFINITIONS

EnCore® Sampler – Sampler designed for collecting Volatile Organic Carbon (VOC) samples.
PPE – Personal Protective Equipment

5.0 REQUIRED MATERIALS

The materials required for this SOP include the following:

- Bound field log books
- Black waterproof and/or indelible ink pens
- Field forms
- Chain of Custody forms
- Sample Labels

6.0 METHOD

The following method outlines general considerations for sample handling in the field and maintaining sample custody after collection.

Environmental samples are collected in the field in order to evaluate whether conditions in soil gas, soil, surface water, or groundwater are hazardous. These samples therefore, should be handled with the utmost care to maintain integrity so that analytical data represents as closely as possible, field conditions. In addition, sample chain of custody is extremely important for establishing that sample integrity was maintained between field crew and laboratory.

Details regarding collection of samples are provided in other SOPs (e.g., soil sampling SOP). General considerations for handling during sampling are:

- Always wear proper PPE when handling samples.
- Sample receptacles or containers should be wrapped in a way that is protective of both surrounding containers and the container the sample is in.
- Always check and document procedures well in field logbooks or sampling forms. There is never “too much information”.

Samples must be stabilized for transport from the field to the laboratory through the use of the proper sample containers and preservation techniques. This is due to the potential changes in chemical quality that may occur after samples are collected. Sample containers and preservation are discussed in the Sample Preservation SOP.

Great care must be exercised in the sampling and handling of volatile compounds (e.g. VOCs or volatile gases) in order to minimize the introduction of sampling bias. This bias is caused largely through the loss of volatile constituents. Special handling procedures are described in respective sampling SOPs for the handling of aqueous and non-aqueous samples that should be followed in order to minimize the loss of volatile constituents.

Non-aqueous samples for VOC analysis should be placed in the appropriate container as quickly as possible following their collection. Consideration should be given to trimming soil samples that have been in contact with the air and the sampling device in order to minimize the loss of VOCs and inadvertent sample contamination, respectively. Some agencies require the use of USEPA Method 5035 (or similar) that utilizes containerization in a special sampler (EnCore® or equivalent), or field methanol preservation using specially prepared containers. Lastly, the sample container should be cooled immediately after it is filled.

6.1 Sample Labels

Sample labels are required on all sample containers for the primary purpose of sample identification. Specific field data need not be recorded on the labels. The sample labels should contain the following information:

- Sample or location identification number (i.e., well number, boring number/depth, or arbitrary sample number)
- Analysis to be performed
- Preservative (even if only keeping sample chilled)
- Project name and number
- Date and time of sample collection
- Details of samplers (initials, etc.)

It is recommended that the sample label be preprinted in the office on adhesive labels prior to initiation of the sampling program. Tape should NOT be used to cover any label or seal the ends of soil sleeves. Recent studies indicate that most commercially available tapes contain VOCs and that there is the potential for contamination from the tapes.

6.2 Chain-of-Custody

The goal of implementing chain-of-custody procedures is to ensure that the sample is traceable from the time that it is collected until it, or its derived data, are used. Samples would be considered to be "in custody" under the following conditions:

- It is in personal possession.
- It is in personal view after being in personal possession.
- It was in personal possession when it was properly secured.
- It is in a designated secure area.

6.2.1 Chain-of-Custody Forms

A chain-of-custody form may be initiated at the time that the sample containers are filled or, at a minimum, when the sample containers leave the site at which they are prepared, usually that of the analytical laboratory supplying the containers. Additionally, chain-of-custody forms may be specially prepared with some initial information for the project and specific analytical methods listed prior to field work to decrease the amount of information that has to be recorded in the field. However, in this event, actual sample collection information should be recorded only in the field after the sample has been collected.

It is important that the field personnel completely fill out the applicable sections of the form. Chain of custody forms should be numerically sequenced with a number clearly indicated on the form. The chain-of-custody forms should be placed in shipping containers, protected from moisture using plastic bags (e.g., Ziploc®), and should accompany the containers during shipment to the laboratory. Chain-of-custody forms included in any shipping container should only reflect those samples that are in that container. The field personnel collecting the samples will be responsible for the custody of the samples until transport to the laboratory. Sample transfer requires the individuals relinquishing and receiving the samples to sign, date and note the time of transfer on the chain-of-custody forms. The chain-of-custody is considered to be complete after it has been received and signed in by the analytical laboratory. A copy of the chain-of-custody record should be maintained by the field personnel along with the other field records.

Common carriers (i.e., Federal Express) are not expected to sign the chain-of-custody form. However, the bill of lading or airbill becomes part of the chain-of-custody record in the event that a common carrier is used to transport the samples. Airbill or bill of lading numbers should be recorded on the chain-of-custody forms.

6.2.2 Chain-of-Custody Seals

Custody seals shall be affixed to the outside of each shipping container or cooler. Two seals are required and should be placed at two points along the front of the cooler at the point where the lid meets the body of the cooler. The seals do not necessarily need to be custody tape, but any type of tape that can be used that cannot be easily removed without showing signs of damage. The custody seals or tape shall include the date and initials of the packager.

Chain-of-custody seals or evidence tape may be used, but are not required, on the sample containers in order to demonstrate that the sample containers have not been opened or otherwise tampered with. Chain-of-custody seals or evidence tape, if used, should be affixed to each sample container as soon after sample collection as is possible.

6.3 Sample Shipment

Shipment of samples to an analytical laboratory is usually required upon completion of sample collection. Proper packaging is necessary in order to protect the sample containers, to maintain the samples at a temperature of 6°C or less, and to comply with all applicable transportation regulations.

In general, samples are shipped using packaging that is supplied by the analytical laboratory. The packaging normally includes a shippable insulated box such as an ice cooler and contains protective internal packaging materials such as foam sleeves or bubble wrap. Some laboratories use proprietary sample packaging with integral internal packaging. In either case, provisions need to be made for maintaining the temperature of the samples either with the use of ice packs or ice. Care should be taken to ensure that the sample bottles are adequately protected from breakage during shipments. Samples should be secured tightly with bubble wrap or other suitable packing media and covered with plastic bags. Ice should be added to the shipping container only after the samples have been secured with packing media. Ice should never be used to provide separation between sample bottles. Once packed, the cooler should be secured shut by wrapping fiber reinforced (strapping) tape completely around the cooler.

Custody seals shall be placed on the outside of the cooler, and clear tape should be wrapped around the cooler to cover each seal without obliterating signatures or other significant data. The shipping label shall be secured to the outside of the shipping container and, if it is attached to the top of a cooler by adhesive, clear tape shall be used to secure it to the packaging. A valid return address must appear on the shipping label in the event the shipper is unable to deliver to the designated address.

Samples will be delivered to the analytical laboratory so that there is sufficient time for analysis of the constituent with the shortest holding time. For holding times, please see SOP-02, Sample Preservation. Samples preserved at 6°C using ice packs or ice shall be shipped via overnight delivery. If samples are sent on Friday, Saturday delivery will be requested and arrangements must be made with the laboratory to receive the shipment. Chemically preserved samples may be delivered to the laboratory using ground transportation.

Regulations must be observed regarding the shipment of Dangerous Goods. Sample containers and certain field equipment may be defined as Dangerous Goods such that special requirements must be followed for their shipment. Air shipment of Dangerous Goods is regulated by the International Air Transport Association (IATA) as described in "Dangerous Goods Regulations". Shipment by ground is regulated by the U.S. Department of Transportation (DOT). Furthermore, individual shippers (e.g., Federal Express) may have additional requirements for Dangerous Goods shipment. The shipment of Dangerous Goods must be consistent with the instruction and authorization of the analytical laboratory shipping and receiving coordinator and the Health and Safety director.

Environmental samples, including groundwater samples, are currently exempt from Hazardous Goods regulations. 40 CFR 261.40(d) states, "A sample of solid waste or a sample of water, soil, or air which is collected for the sole purpose of testing to determine its characteristics or composition is not subject to this Part or Parts 262 through 267 or Part 124 of this chapter or to the notification requirements of Section 3010 of RCRA." Therefore, no special regulations are required to be followed for the shipment of environmental samples from the field. However, sample containers should be properly packed such that inadvertent spillage does not occur during shipment (e.g., any discharge spouts should be taped closed). Samples of NAPL do not fall under this exemption.

Specific regulations do exist, however, for the shipment of many reagents that are commonly used as preservatives and decontamination agents. Consequently, the shipment to the field site of "empty" sample containers containing small quantities of preservatives must be conducted in accordance with the regulations. The most significant limitations for the shipment of preservatives (IATA, 1992) involve those for nitric acid in which only small quantities (<0.5L) of low concentration (<20%) nitric acid can be shipped in any given shipment.

7.0 QUALITY ASSURANCE/QUALITY CONTROL

Quality assurance for sample handling centers upon following procedures outlined above and double checks as samples are collected. Checks should be performed either by 1) the field personnel, or, preferably, 2) by a project chemist or other personnel that constantly check field chain of custody forms versus laboratory receipt acknowledgment forms, discuss condition of samples as received by laboratory personnel, and communicate constantly with the laboratory project manager to prevent quality assurance issues from starting or becoming significant problems should they occur.

8.0 REFERENCES

United States Environmental Protection Agency, 1984, Soil Sampling Quality Assurance Users Guide, EPA/600/4-84/043.

United States Environmental Protection Agency, 1986, RCRA Ground-Water Monitoring Technical Enforcement Guidance Document, OSWER-9950.1.

United States Environmental Protection Agency, 1987, A Compendium of Superfund Field Operations Methods, EPA/600/P-87/001.

United States Environmental Protection Agency, 1992, RCRA Ground-Water Monitoring: Draft Technical Guidance, EPA/600/R-92/001.

9.0 ATTACHMENTS

None

SOP-02
Sample Preservation

Yerington Mine Site
Standard Operating Procedure

Revision 3
Revision Date: May 5, 2008

SOP-02
SAMPLE PRESERVATION

TABLE OF CONTENTS

1.0 OBJECTIVES

The objective of this standard operating procedure (SOP) is to establish procedures that allow the chemical integrity of a sample is maintained from time of collection until chemical analysis.

2.0 APPLICABILITY

This SOP documents the procedures and chemicals to be used for the preservation of field samples. The environmental media addressed in this SOP include soil, sediment, solid waste, and aqueous samples. These procedures apply to all Project team personnel and subcontractors involved with the collection, shipping and chemical analysis of environmental samples.

3.0 RESPONSIBILITY

The *Project Manager (PM),* or designee, shall ensure that the sampling procedures used, including provisions for proper storage, preservation and shipping, are adequate to maintain sample integrity until custody is assumed by the laboratory. The PM shall develop or direct the preparation of a detailed sampling plan for sampling air, water, biota, sediment, soil, or waste, which shall describe the procedures used to preserve samples during the interval from sampling until receipt by the laboratory.

The *Project Chemist (PC),* or designee, shall ensure that the samples are collected in terms of the analytical methods and compliance with sampling protocols. For smaller projects, the PC and the Field Supervisor may be the same person. The field supervisor or PC also are responsible for maintaining adequate supplies of containers and preservatives. The PM will determine the roles and personnel for each project.

The *Field Supervisor* or his or her designate shall be responsible for ensuring the competence of field sampling personnel and their training. The field supervisor shall ensure that specified preservation and storage procedures are followed during sampling and during shipment to the laboratory.

The *field sampling personnel* will be responsible for the understanding and implementation of this SOP during all field activities. Field personnel are also responsible for checking the collected samples, and verifying that they are preserved with prescribed range.

4.0 REQUIRED MATERIALS

The materials required for this SOP include the following:

- Sample Containers,
- pH instrument or Litmus paper with appropriate pH range,
- Field notebook, and

- Sampling forms (e.g. Chain of Custody Records, sample labels).

5.0 DEFINITIONS

Maximum Holding Time. Maximum Holding Time is the maximum length of time that may elapse before sample preparation (extraction or digestion) or analysis is completed. It is calculated from the date and time of collection in the field. Holding times are usually measured to the nearest day with the exception of those analyses that must be completed within 24 or 48 hours.

Preservation. Preservation refers to temperature control and/or pH adjustment procedures performed to prevent or slow the loss of target analytes through precipitation, volatilization, decomposition, or biodegradation.

Temperature. Temperature is defined as the temperature within the refrigerator, cooler or ice chest that holds the samples. Samples shall be held at 6 degrees Celsius (°C) or less.

6.0 METHODS

Proper communication between the project manager and the analytical laboratory is essential prior to sampling, preferably in writing. This is necessary so that the proper type and number of containers and preservatives can be specified and so that all technical and regulatory requirements can be met regarding the analyses.

Field personnel should coordinate in writing with the laboratory at least two weeks before the sample container kits are to be shipped from the lab to identify the analytes to be requested. The information exchange between lab and field personnel include the project identification, sample kit shipment address, QA/QC regulatory requirements, required turnaround requirements, and the number and type of laboratory analyses.

Most chemical and biological reactions and many physical processes are slowed by lowering the temperature. Therefore, as a general rule, all samples need to be cooled at the time of collection and maintained slightly above freezing until preparation for final analysis. This restriction is not critical in the case of metals analysis since most metals exist in the form of involatile salts with the exception of liquid mercury and organometallic compounds such as tetraethyl lead, which still need to be kept cold. Hexavalent chromium is kept cold to slow its reduction to trivalent chromium.

Soil samples and other solid samples, including sediments, sludges, and solid waste, shall be preserved by cooling to 6° C. Soil and solid samples require no chemical preservatives. However, analysis must be performed within the method-specific holding time requirements.

Aqueous samples may be presumed to be homogenous and amenable to chemical preservation. The following general approaches for chemical preservation shall be employed depending on the analyte(s):

- Volatile acids (HCN, H_2S) are rendered involatile in the presence of strong base (NaOH, pH>12);
- Volatile bases (ammonia) are rendered involatile in the presence of strong acid (H_2SO_4, pH<2);
- Biodegradation of organic compounds is retarded under strongly acidic conditions (HCl or H_2SO_4, pH<2);
- Dehydrohalogenation (loss of HCl) of chlorinated solvents is counteracted in the presence of acid (HCl, pH<2);
- Oxidation of target analytes by the chlorine found in drinking water is eliminated by destroying the chlorine with a reducing agent such as sodium thiosulfate; and
- Many soluble metal salts tend to adhere to the walls of the container or they form precipitates with time. This can be prevented by the addition of nitric acid to a pH of < 2, which maintains the metals as soluble nitrate salts.

Groundwater samples for dissolved metals analysis are filtered (usually with a 0.45 micron filter) before preservation with the appropriate preservative. The filtrate is added directly to the plastic container, which has been supplied with the proper amount of preservative.

With the exception of the stainless-steel sleeves used to capture soil boring samples, all sample containers will be supplied in advance by the subcontracting laboratories.

The required chemical preservatives for aqueous samples will normally be added to the appropriate containers by the subcontracting laboratories before delivery to the field. There are two reasons why already-preserved containers are preferred. First, the laboratory scheduled to perform the analysis maintains control over sample integrity and container cleanliness and, second, field crews are generally not equipped to "appropriately handle" hazardous chemicals like hydrochloric acid. Laboratories will check the pH of incoming samples to ensure they have been properly preserved. If additional acid must be added to the samples by the lab, they shall notify the Project Chemist or Field Supervisor and the samples must sit for an additional 18 hours before analysis.

Sample preservatives should be identified on the chain of custody (COC).

Solid samples, whether in metal sleeves, wide-mouth glass jars, or other containers, will be labeled and secured appropriately, then placed immediately in an ice chest containing sufficient ice to maintain a temperature range of 6° C through delivery to the laboratory.

Sufficient ice chests and quantities of ice to manage all samples collected during the day (or shift) shall be maintained at the sampling site.

Samples are maintained in ice or, if available, in refrigerators, within a range of 6° C, from the time the sample control manager assumes custody until the samples are packed for shipment and relinquished to the shipper or other transport agent.

All samples are shipped in ice chests packed with sufficient ice to maintain a temperature range of 6° C for at least 24 hours.

One temperature blank shall be placed in the center of each cooler for the laboratory to check the temperature upon arrival at the lab. The temperature blank can be created in the field by pouring deionized water into an empty, unpreserved 40 mililiter VOA or other sample container and should be labeled as a temperature blank and added to the COC to record that it was placed into the cooler.

The receiving laboratory will measure the temperature within the ice chest immediately upon assuming custody of a shipment of samples. This temperature will be noted on the chain-of-custody form. Temperatures in excess of 6° C will be reported immediately to the project chemist. After consultation with the PM, the PC will communicate whether re-sampling is necessary.

Table 1 is a listing of the common analyses with associated containers, preservatives, and holding times. The analyses and associated other data shown in Table 1 give a general background regarding what is required. However, when particular analytical procedures are specified in planning documents, it is best to check directly with the cited method to make sure sample vessels and preservatives are correct.

7.0 REFERENCES

American Public Health Association, 1985. Standard Methods for the Examination of Water and Wastewater, 16th Edition.

40 CFR 136, Code of Federal Regulations, dated July 1, 1990.

United Stated Environmental Protection Agency (USEPA), 1991. Statement of Work for Organics Analysis, Document Number OLMO1.0, USEPA Contract Laboratory Program, June.

United States Environmental Protection Agency (USEPA), 1990a. Statement of Work for Inorganics Analysis, Document Number ILMO1.0, USEPA Contract Laboratory Program, March. November.

EPA (U.S. Environmental Protection Agency), 1990b. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Third Edition, Final Update I, USEPA Office of Solid Waste,

United States Environmental Protection Agency (USEPA), 1982. Methods for Chemical Analysis of Water and Wastes, EPA-600/4-82-055, December

8.0 ATTACHMENTS

Table 1. Sample Containers, Preservation Methods, and Analytical Holding Times

Table 1
Sample Containers, Preservation Methods, and Analytical Holding Times (1 of 2)

Parameter	Matrix	Container	Lid	Preservation	Maximum Holding Times	
					Extraction[a]	Analysis[b]
Metals	Water	500 ml polyethylene	Cap with Teflon® seal	HNO3 to pH<2 (Hg: Ice to [6°C)	-	6 months (Hg: 28 days)
	Soil	4 oz. glass jar	Teflon®-lined lids	none (Hg: Ice to [6°C)	-	6 months (Hg: 28 days)
	Soil	Stainless steel sleeve	Teflon®-lined plastic end-caps	none (Hg: Ice to [6°C)	-	6 months (Hg: 28 days)
Radionuclides	Water	500 ml polyethylene	Cap with Teflon® seal	HNO3 to pH<2	-	6 months
	Soil	4 oz. glass jar	Teflon®-lined lids	none	-	6 months
	Soil	Stainless steel sleeve	Teflon®-lined plastic end-caps	none	-	6 months
Volatiles	Water	40 ml glass vials X 3	Cap with Teflon® septum	HCl to pH<2; Ice to [6°C	-	14 days
	Soil	EnCore sampler X 3	o-ring cap	Ice to [6°C; 48 hours to preserve with methanol or sodium bisulfate	-	14 days
	Soil	Stainless steel sleeve	Teflon®-lined plastic end-caps	Ice to [6°C	-	14 days
Purgeable Hydrocarbons	Water	1 liter glass amber jar	Cap with Teflon® septum	HCl to pH<2; Ice to [6°C	-	14 days
	Soil	EnCore sampler X 3	o-ring cap	Ice to [6°C	-	14 days
	Soil	Stainless steel sleeve	Teflon®-lined plastic end-caps	Ice to [6°C	-	14 days
Extractable Hydrocarbons	Water	1 liter glass amber jar X 2	Teflon®-lined caps	Ice to [6°C	7 days	40 days
	Soil	4 oz. glass jar	Teflon®-lined lids	Ice to [6°C	14 days	40 days
	Soil	Stainless steel sleeve	Teflon®-lined plastic end-caps	Ice to [6°C	14 days	40 days
Total Recoverable Petroleum Hydrocarbons	Water	1 liter glass amber jar X 2	Teflon®-lined caps	H2SO4 to pH<2; Ice to [6°C	-	28 days
	Soil	4 oz. glass jar	Teflon®-lined lids	Ice to [6°C	-	28 days
	Soil	Stainless steel sleeve	Teflon®-lined plastic end-caps	Ice to [6°C		28 days
	Soil (volatiles)	Encore sampler	o-ring cap	Ice to [6°C; methanol within 48 hr	-	14 days
Phenols	Water	1 liter glass amber jar X2	Teflon®-lined caps	Ice to [6°C	7 days	40 days
	Soil	4 oz. glass jar	Teflon®-lined lids	Ice to [6°C	14 days	40 days
	Soil	Stainless steel sleeve	Teflon®-lined plastic end-caps	Ice to [6°C	14 days	40 days
Organochloride Pesticides and PCBs	Water	1 liter glass amber jar X2	Teflon®-lined caps	Ice to [6°C	7 days	40 days
	Soil	4 oz. glass jar	Teflon®-lined lids	Ice to [6°C	14 days	40 days
	Soil	Stainless steel sleeve	Teflon®-lined plastic end-caps	Ice to [6°C	14 days	40 days
Chlorinated Herbicides	Water	1 liter glass amber jar X2	Teflon®-lined caps	Ice to [6°C	7 days	40 days
	Soil	4 oz. glass jar	Teflon®-lined lids	Ice to [6°C	14 days	40 days
	Soil	Stainless steel sleeve	Teflon®-lined plastic end-caps	Ice to [6°C	14 days	40 days
Semivolatiles	Water	1 liter glass amber jar X2	Teflon®-lined caps	Ice to [6°C	7 days	40 days
	Soil	4 oz. glass jar	Teflon®-lined lids	Ice to [6°C	14 days	40 days
	Soil	Stainless steel sleeve	Teflon®-lined plastic end-caps	Ice to [6°C	14 days	40 days

Table 1
Sample Containers, Preservation Methods, and Analytical Holding Times (Page 2 of 2)

Parameter	Matrix	Container	Lid	Preservation	Maximum Holding Times: Extraction[a]	Maximum Holding Times: Analysis[b]
Dioxins and Furans	Water	1 liter glass amber jar X2	Teflon®-lined caps	Ice to [6°C	28 days	40 days[a]
	Soil	4 oz. glass jar	Teflon®-lined lids	Ice to [6°C	28 days	40 days
	Soil	Stainless steel sleeve	Teflon®-lined plastic end-caps	Ice to [6°C	28 days	40 days
Polynuclear Aromatic Hydrocarbons	Water	1 liter glass amber jar X2	Teflon®-lined caps	Ice to [6°C	7 days	40 days
	Soil	4 oz. glass jar	Teflon®-lined lids	Ice to [6°C	14 days	40 days
	Soil	Stainless steel sleeve	Teflon®-lined plastic end-caps	Ice to [6°C	14 days	40 days
Nitroaromatics and Nitroamines	Water	1 liter glass amber jar X2	Teflon®-lined caps	Ice to [6°C	7 days	40 days
	Soil	4 oz. glass jar	Teflon®-lined lids	Ice to [6°C	14 days	40 days
	Soil	Stainless steel sleeve	Teflon®-lined plastic end-caps	Ice to [6°C	14 days	40 days
Nitroglycerine	Water	1 liter glass amber jar X2	Teflon®-lined caps	Ice to [6°C	7 days	40 days
	Soil	4 oz. glass jar	Teflon®-lined lids	Ice to [6°C	14 days	40 days
	Soil	Stainless steel sleeve	Teflon®-lined plastic end-caps	Ice to [6°C	14 days	40 days
Anions (Cl, nitrate, nitrite, & sulfate)	Water	250 ml polyethylene	Teflon®-lined caps	Ice to [6°C (Cl: none)	-	28 days (NO3 and NO2:48 hrs)
	Soil	4 oz. glass jar	Teflon®-lined lids	Ice to [6°C (Cl: none)	c	28 days (NO3 and NO2:48 hrs)
	Soil	Stainless steel sleeve	Teflon®-lined plastic end-caps	Ice to [6°C (Cl: none)	c	28 days (NO3 and NO2:48 hrs)
Ignitability	Water	250 ml polyethylene	Teflon®-lined caps	none	none	none
	Soil	4 oz. glass jar	Teflon®-lined lids	none	none	none
	Soil	Stainless steel sleeve	Teflon®-lined plastic end-caps	none	none	none
Total Cyanide	Water	1 liter polyethylene	Teflon®-lined caps	NaOH to pH>12; Ice to [6°C	c	14 days
	Soil	4 oz. glass jar	Teflon®-lined lids	Ice to [6°C	c	14 days
	Soil	Stainless steel sleeve	Teflon®-lined plastic end-caps	Ice to [6°C	c	14 days
Hexavalent Chromium	Water	1 liter glass amber jar X2	Teflon®-lined caps	Ice to [6°C	c	24 hours
	Soil	4 oz. glass jar	Teflon®-lined lids	Ice to [6°C	30 days	4 days
	Soil	Stainless steel sleeve	Teflon®-lined plastic end-caps	Ice to [6°C	30 days	4 days
pH	Water	250 ml polyethylene	Teflon®-lined caps	none	-	immediate
	Soil	4 oz. glass jar	Teflon®-lined lids	none	c	immediate
	Soil	Stainless steel sleeve	Teflon®-lined plastic end-caps	none	c	immediate
Field Soil gas	Air or Soil gas	Tedlar bag	None	none	-	3 days
	Air or Soil gas	Summa Canister	None	none	-	14 days

Abbreviations:
ml = milliliter
oz = ounce

a = Starting from the date of collection
b = Starting from the date of extraction; if no extraction is involved, starting from the date of collection
c = Extraction may occur any time prior to analysis. Only the analysis holding time is monitored.

SOP-03
Field Notes and Documentation

Yerington Mine Site
Standard Operating Procedure

Revision 0
Revision Date: June 6, 2006

SOP-03
FIELD NOTES AND DOCUMENTATION

TABLE OF CONTENTS

1.0 OBJECTIVES

The objective of this standard operating procedure (SOP) is to establish a consistent method and format for the use and control of documentation generated during daily field activities. Field notes and records are intended to provide sufficient information that can be used to recreate the field activities, as well as, the collection of environmental data. Information placed in these documents and/or records shall be factual, detailed and objective.

2.0 SCOPE AND APPLICABILITY

This procedure will be used during all field activities, regardless of the purpose by all project team personnel and subcontractors who conduct field investigations. These activities may include, but are not limited to, all types of media sampling (soil vapor, soil, groundwater, wastewater, etc), utility clearance, well installation, sample point locating and surveys, site reconnaissance, free product removal, remediation, and waste handling.

3.0 RESPONSIBILITY

The *Project Manager (PM),* or designee, will have the responsibility to oversee and ensure that field documentation is collected in accordance with this SOP and any site-specific or project specific planning documents.

The *field sampling personnel* will be responsible for the understanding and implementation of this SOP during all field activities, as well as, obtaining the appropriate field logbooks, forms and records necessary to complete the field activities. Field personnel shall ensure all field activities are documented completely at the end of each field day. Field personnel are responsible for tracking the location of all field documentation, including field logbooks. Field personnel are responsible for assuring that the original documentation (or copies of the field log book, if needed for another project at the same site), are filed at the end of the field project or during a long project (greater than month) every couple of weeks.

4.0 REQUIRED MATERIALS

The materials required for this SOP include the following:

- Bound field logbooks, and
- Black waterproof and/or indelible ink pens
- Field Forms

5.0 METHODS

This SOP primarily includes the documentation procedures for the field logbooks. However, procedures discussed in this SOP are applicable to all other types of field documentation collected, and should be universal in application. Details of other field records and forms (e.g. boring logs, sample labels, chain of custody records, and waste containment labels are discussed in the specific SOP associated with that particular field activity (e.g. borehole drilling, sample handling, investigative derived waste), and not covered in detail in this SOP.

5.1 Field Logbooks

Field personnel will keep accurate written records of their daily activities in a bound logbook that will be sufficient to recreate the project field activities without reliance on memory. This information will be recorded in chronological order. All entries will be legible, written in black waterproof or indelible ink, and contain accurate and inclusive documentation of field activities, including field data observations, deviations from project plans, problems encountered, and actions taken to solve the problem. Each page of the field logbook will be consecutively numbered, signed and dated by the field author(s). Pages should not be removed for any reason.

There should be no blank lines on a page. A single blank line or a partial blank line (such as at the end of a paragraph) should be lined to the end of the page. If only part of a page is used, the remainder of the page should have an "X" drawn across it.

In addition to documenting field activities, field logbooks will include, but are not limited to, the following:

- Date and time of activities,
- Site location
- Purpose of site visit,
- Site and weather conditions,
- Personnel present, including sampling crew, facility/site personnel and representatives (including site arrival and departure times),
- Subcontractors present,
- Regulatory agencies and their representatives (including phone numbers, site arrival and departure times),
- Level of health and safety protection,
- Sampling methodology and information,
- Sample Locations (sketches are very helpful),
- Source of sample(s), sample identifications, sample container types and preservatives used, and lot numbers for bottles and preservatives (if applicable and if not recorded on other forms or in a sample control logbook),
- A chronological description of the field observations and events,
- Specific considerations associated with sample acquisition (e.g., field parameter measurements, field screening data, HASP monitoring data, etc.) (if not recorded on another form),
- Wastes generated, containment units (including volumes, matrix, etc), and storage location (if not recorded on another form),
- Field quality assurance/quality control samples collection, preparation, and origin (if not recorded on other forms or in a sample control logbook),

- The manufacturer, model and serial number of field instruments (e.g., OVM, water quality, etc.) shall be recorded, if not using a calibration form. Also, source lot # and expiration date of standard shall be recorded if calibrated in the field.
- Well construction materials, water source(s), and other materials used on-site (if not recorded on another form).
- Sample conditions that could potentially affect the sample results,
- If deviating from plan, clearly state the reason(s) for deviation,
- Persons contacted and topics discussed,
- Documentation of exclusion zone set-up and location,
- Documentation of decontamination procedures, and
- Daily Summary.

Field situations vary widely. No general rules can specify the extent of information that must be entered in a logbook. However, records should contain sufficient information so that someone can reconstruct the field activity without relying on the collector's memory. Language used shall be objective, factual, and free of personal opinions. Hypothesis for observed phenomena may be recorded, however, they must be clearly indicated as such and only relate to the subject observation.

Logbooks will be assigned to a specific sampling team. If it is necessary to transfer the log book to alternative team member during the course of field work, the person relinquishing the log book will sign and date the log book at the time of transfer.

Field logbooks should consist of a bound book, in which the insertion or removal of pages will be visibly noticeable after the logbook has been assembled. Logbooks can be prepared by gluing or laminating pages together either at the left side or top of the page. If inclement weather is expected, logbooks may have plastic laminated front and back covers to protect the interior pages, and should not be broken apart for coping. Loose-leaf binding, such as comb binding is not considered hard binding. To maintain the integrity of the logbook, pages should be consecutively numbered prior to use. Logbook pages can be of any format, and may include blank pages for recording or field forms that are used for specific tasks. As an alternative, commercially bound and consecutive page numbered field logbooks may also be used.

5.2 Photographs

Photographs provide the most accurate demonstration of the field worker's observations. They can be significant to the field team during future inspections, informal meetings, and hearings. Photographs should be taken with a camera-lens system having a perspective similar to that afforded by the naked eye. Telephoto or wide-angle shots cannot be used in enforcement proceedings. Some industrial clients do not permit photographs on their sites. In industrial settings, confirm with the project manager that photographs are allowed.
A photograph must be documented if it is to be a valid representation of an existing situation. Therefore, for each photograph taken, several items shall be recorded in the field logbooks:

- Date and time photograph taken;
- Name of photographer;
- Site name, location, and field task;
- Brief description of the subject and the direction taken; and
- Sequential number of the photograph.

5.3 Additional Field Forms/Records

Additional field records may be required for each specific field event. The use of these records and examples are described in other SOPs specific for the activity (e.g. Borehole Logging SOP, Groundwater Sampling and Purging SOP, etc.). These other records may include:

- Borehole Logs during drilling,
- Well Construction and Development records,
- Groundwater Purge and Sample Collection Records,
- Water Level Monitoring,
- Investigation Derived Waste (IDW) Tracking Records,
- Instrument Calibration Records, and
- Health and Safety Monitoring Records and sign-off sheets.

Prior to field activities, the field sampling personnel will coordinate with the Project Manager, or designee, to determine which additional records will be required for the specific field task. These additional records will be maintained in a field file or a three-ring notebook throughout the duration of the field activities, or included in a specially prepared site-specific notebook. If the field notebook is being created, the forms may be part of the laminated book.

6.0 CORRECTIONS

If an error is made in the field, logbook corrections will be made by drawing a single line through the error, entering the correct information, and initialing and dating the change. Materials that obliterate the original information, such as correction fluids and/or mark-out tapes, are prohibited. All corrections will be initialed and dated. Some projects require that a brief reason for the change must also be added where the correction was made. Ask the Project Manager, if this requirement is necessary.

7.0 DOCUMENTATION REVIEWS

Periodically, the Project Manager, or designee, will review the field logbooks pertaining to the activities under their supervision. The elements of this review will include technical content, consistency, and compliance with the project plans and SOPs. Discrepancies and errors identified during the review should be resolved between reviewer and author of the field documentation. Corrections and/or additions of information shall be initialed and dated by the field author or reviewer.

8.0 FIELD RECORD BACKUP

Periodically, the Project Manager, or designee, will determine if and when field logbooks and records need to be photocopied. Photocopies will be maintained in the project files, and can be used as backup in the event that the original field logbook or records are lost or damaged.

9.0 DOCUMENTATION ARCHIVE

At the completion of the project, all original field logbooks and records will be store in the project files in accordance with project procedures. Typically project files lifetimes are controlled and spelled out in contractual agreements with clients. Typically, project files are archived after project finalization and kept indefinitely in archive.

10.0 REFERENCES

None cited.

11.0 ATTACHMENTS

None listed.

SOP-05
Equipment Decontamination

Yerington Mine Site
Standard Operating Procedure

Revision 0
Revision Date: June 6, 2006

SOP-05
EQUIPMENT DECONTAMINATION

TABLE OF CONTENTS

1.0 OBJECTIVES

The objective of this standard operating procedure (SOP) is to establish consistent methods to reduce or eliminate:

- Contamination and cross-contamination of environmental samples by sample equipment, other samples, or personnel.
- Health and environmental risk caused by the spread of contaminants.

2.0 APPLICABILITY

Decontamination should occur any time a sampling tool or instrument used in field investigations may contact sampled media, or personnel using the equipment. This procedure will be used in conjunction with reusable equipment, but is not required for dedicated equipment, used during field activities associated with handling, sampling or measuring environmental media such as soil, groundwater, soil gas, or air. These procedures are to be implemented primarily on-site such as at the point of use or at a designated equipment decontamination station at the project site. Equipment decontamination should be completed before each use and prior to transporting off-site.

Examples of soil and groundwater sample collection equipment usually requiring decontamination includes pumps, bailers, tubing, hand augers, split spoon samplers, and other related equipment used for the collection of samples or the measurement of field parameters.

These procedures are general minimum standards. They may be modified or supplemented for a specific project by site-specific work plans or health and safety plans.

3.0 RESPONSIBILITY

The *Project Manager*, or designee, will have the responsibility to oversee and ensure that equipment decontamination procedures are implemented in accordance this SOP and any site-specific work plan, field sampling plan (FSP), quality assurance project plan (QAPP), and site health and safety plan (SHSP).

The *field personnel* will be responsible for the understanding and implementation of this SOP during all field activities, as well as, obtaining the appropriate field logbooks, forms and records necessary to complete the field activities.

4.0 REQUIRED MATERIALS

The equipment and supplies required for this SOP include the following:

- Clean buckets or tubs to hold wash and rinse solutions of a size appropriate to the equipment to be decontaminated.
- Tap water.

- Deionized or distilled water (grade determined by project requirements. Many projects require “organic free” or ASTM Type II water).
- Nitric acid.
- Long-handled brushes for scrubbing. Flat-bladed scrapers, garden type spray bottles (no oil lubricated parts).
- Non-phosphate detergent such as Alconox® or Liqui-Nox®.
- Plastic sheeting for the decontamination area.
- Drums to hold waste decontamination solutions and expendable supplies.
- Drum labels to properly identify the contents of the drum (more information about drum labels is included in the SOP for Investigation Derived Waste Handling Procedures)
- Plastic bags and/or aluminum foil to keep decontaminated equipment clean until the next use.
- Gloves, aprons, safety glasses, and any other PPE required in the Site Health and Safety Plan (SHSP).
- Towels and wipes.
- Dispensing bottles.
- Methanol and/or Hexane (if required by the project work plan or quality assurance plan).
- Sump and collection system for waste derived liquids.

Some Work Plans may include additional equipment rinses based on the contaminants being investigated. Examples of this are 0.1N nitric acid when cross-contamination from metals is a concern, and solvents such as methanol, isopropanol, or hexane, when cross-contamination from organics is a concern. If these are required, labeled inert dispensing bottles and Material Safety Data Sheets (MSDS) for these rinses will be necessary. Labels should be well marked. MSDS’ should be filed on site and hazard communication needs to occur as outlined in the Site Safety Plan.

5.0 METHODS

Decontamination consists of physically removing contaminants from personnel or equipment. To prevent the transfer of harmful materials, procedures have been developed and are implemented before anyone enters a site and continue throughout site operations.

A decontamination plan should be based on the worst-case scenario (if information about the site is limited). The plan can be modified, if justified, by supplemental information. Initially, the decontamination plan assumes all protective clothing and equipment which leave the exclusion zone are contaminated. Based on this assumption, a system is established to wash and rinse all non-disposable equipment. Decontamination plans will be site-specific and presented in the SHSP for each site.

The decontamination area should be located, if possible, where decontamination fluids and soil wastes can be easily discarded or discharged after receipt of analytical results which determine if discharge parameters have been met. Decontamination wastewater should be managed in accordance with the Investigation Derived Waste SOP or as directed in the work plan or quality assurance plan. Wastewater will be collected and stored onsite until it can be properly disposed.

5.1 Decontamination Station Set-up

Large equipment. A decontamination pad should be established for cleaning of heavy equipment or large sampling tools. This pad can be a prefabricated area that already exists on site for washing large equipment, or can be constructed. If a prefabricated area exists, it needs have characteristics that allow for collecting fluids and solids that will fall off the large equipment. Decontamination pads can be constructed in a variety of ways, but things to consider during construction are the following:

- The pad will need to be constructed so it provides complete secondary containment. Hence all sides will require berms to prevent off pad migration of fluids. The berms need to be constructed by considering the balance between sump pump removal rates and the amount of fluid that will be generated.
- Fluids from decontamination processes cannot escape and be directly discharged vertically into the ground; hence if plastic sheeting is used it should be minimally double layered and thick (greater than 8 mil).
- The pad will have to drain in one general direction where a sump pump can collect fluids.
- The pad will need to be located near power and water, if possible. However, a generator can supply power and water can be trucked in.

Small equipment. For small equipment decontamination and PPE decontamination a smaller station is established, either in the contaminant reduction zone or at the sampling location or well if contamination zones are not established. For this station, clean buckets or tubs (5 gallon buckets are most common) should be used. Buckets should be placed on plastic sheeting to prevent spillage to the ground, and to help keep the decontamination area and equipment as clean as possible. The buckets should be filled half to three-quarters full as follows:

Step 1 Tap water with non-phosphate detergent such as Liqui-Nox made up as directed by the manufacturer.

Step 2 Tap water for rinsing.

Step 3 2% nitric acid solution mixed with deionized or distilled water for the second rinsing

Step 4 Deionized or distilled water for the final rinsing

A clean area, generally covered with plastic sheeting or large clean plastic bags, is also needed to set down decontaminated equipment prior to reuse or air drying and packaging for later use. A stainless steel rack (e.g., grill for barbecue) can often help drying activities.

5.2 Procedure

After the decontamination area is set up, equipment decontamination is comprised of four general steps:

1) Removal of gross (visible) contamination
2) Removal of residual contamination
3) Prevention of recontamination, and
4) Disposal of wastes associated with the decontamination

5.2.1 Remove Gross Contamination

Gross contamination generally applies to soil sampling equipment, which may have significant residue clinging to the piece of equipment. This can be removed by dry brushing or scraping or by a high-pressure steam or water rinse often, in areas not grossly contaminated, steam washes may be all that is applied to larger equipment, such as drill casings. If utilizing high-pressure steam or water, the rinse water should be containerized as investigation derived waste. Since a significant amount of wastes may be generated, this operation is often best conducted on a decon pad, which has been designed as a secondary containment area to collect wastes.

5.2.2 Remove Residual Contamination

All sampling equipment used at the site must be cleaned prior to any sampling effort, after each sample is collected, and after the sampling effort is accomplished.

Removal of residual contamination consists of the following steps:

1) Place the item in the first bucket (detergent wash) and scrub the entire surface area of each piece of equipment to be decontaminated. Utilize scrub brushes to remove all visible contamination. Change the water periodically to minimize the amount of residue carried over into the second rinse.

2) Place the item in the second bucket (clear water rinse – tap or deionized water) and rinse. Change the water periodically to minimize the amount of residue carried over into the third rinse.

3) Rinse the item with a weak nitric acid solution, either in a bucket or with a squeeze bottle. The purpose of the nitric acid wash is to remove any remaining metals that may contaminate the equipment. The acid solution is very weak but use extra caution to minimize contact with the solutions, including heavier gloves and goggles. Change water as necessary.

4) Place the item in the fourth bucket (deionized or distilled water) and repeat the rinsing procedure. Change water as necessary.

5) Unless the Work Plan directs additional rinses, place the item on a clean surface such as plastic sheeting to await reuse or packaging for storage (e.g., wrapping foil).

Additional rinses for field sampling equipment are sometimes called for in the Work Plan. This may include a pesticide-grade solvents (e.g., methanol, isopropanal, or hexane) when organic contamination may be present. These rinses are applied with a wash bottle so that the stream of liquid has completely covered the area of surface of the equipment that may come in contact with the sample. The rinse should be conducted over a container to catch the runoff from the equipment.

Solvent rinses should be conducted from more polar (i.e., methanol) to less polar (i.e. hexane or methylene chloride), and allowed to air dry if at all possible. Application of the methanol and hexane rinses requires liberal amounts of hexane to remove the methanol. Under some circumstances (e.g., poor weather), complete air drying of equipment is impractical. In such a case, allowing the equipment to dry as long as practical followed by an organic free water rinse can be used.

5.2.3 Prevent Recontamination After Decontamination

After the decontamination process, equipment should be stored to preserve its clean state to the extent practical. The method will vary by the nature of the equipment. Protection measures include covering or wrapping in plastic or sealable plastic bags, or wrapping with oil-free aluminum foil.

5.2.4 Disposal of Contaminants and Spent Rinse Fluids

All washing and rinsing solutions are considered investigation derived waste and should be containerized. After use, gloves and other disposable PPE should also be containerized and handled as investigation derived waste. See SOP on Investigation Derived Waste Handling Procedures.

5.3 Record Keeping

The decontamination method should be documented within the field documentation designated for the project. Entries documenting the procedure used, fluids used, lot numbers for fluids, and any changes and approval for changes should be entered into a bound field notebook or on project-specific forms. Upon completion of the field activity, it is the responsibility of the field personnel to ensure the project/task manager receives copies of all of the field documentation.

6.0 REFERENCES

Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities. October 1985.

United States Environmental Protection Agency (U.S. EPA), 1990. Procedures to Schedule and Complete Sampling Activities in Cooperation with EPA Region VII Environmental Services Division. February.

U.S. EPA Region VII, 1991. Environmental Services Division Operations and Quality Assurance Manual. February.

U.S. EPA, 1987. A Compendium of Superfund Field Operations Methods, Volumes I and II. EPA/540/P-87/001a&b.

U.S. EPA, 1992. Standard Operating Safety Guidelines; Publication 9285.1-03. June.

The Code of Federal Regulations, 1993. Title 29, 1910.120. July.

7.0 ATTACHMENTS

None.

SOP-11
Soil Sampling

Yerington Mine Site
Standard Operating Procedure

Revision 0
Revision Date: June 6, 2006

SOP-11
SOIL SAMPLING

TABLE OF CONTENTS

1.0 PURPOSE

The objective of this standard operating procedure is to provide standardized methods for the field collection of soil samples using manual or rig-assisted techniques.

2.0 SCOPE AND APPLICABILITY

This procedure specifies the methods to be followed by the field personnel for the collection of surface and subsurface soil samples. The collection techniques and equipment selected are dependent on the nature of subsurface soil conditions (i.e., degree of consolidation and moisture content), depth of the desired sample, type of sample required, type of soil being sampled, and analytical and/or geotechnical laboratory testing methods that will be requested for the sample.

Soil samples are used to determine the physical, hydrogeologic, and chemical properties of site soil. Analytical data aid in the characterization of the site, identification of hazardous substance source areas, and determination of the nature and extent of contamination. Typically a project Work Plan will be prepared that details sample locations, numbers, analytical methods, and specific field techniques that may be required. Different SOPs will be referenced in the Work Plan to provide detailed descriptions of how each procedure will be conducted. The project Work Plan may or may not include a field sampling plan (FSP) and Quality Assurance Project Plan (QAPP) based on client requirements. Proper sampling techniques, proper selection of sampling equipment, and proper decontamination procedures as outlined in the project Work Plan eliminates cross-contamination and introduction of contaminants from external sources.

Detailed records will be maintained during sampling activities, particularly with respect to location, depth, color, odor, lithology, hydrogeologic characteristics, and readings derived from field monitoring equipment. These records will be prepared following the SOP for Field Documentation. All soils are classified in the field by a geologist, hydrogeologist, or soil scientist using the Unified Soil Classification System (USCS), and as described in the SOP for Field Classification and Description of Soils. Color of the samples is determined in the field using a Munsell Color Chart.

3.0 RESPONSIBILITIES

The *Project Manager* develops or directs the preparation of a Work Plan, which describes the sampling procedures to be used and ensures that the procedures achieve the objectives of the investigation.

The *Field Supervisor* ensures that soil samples are collected according to procedures outlined in the project Work Plan or provides rational and justifiable decisions in circumstances where deviations from the project Work plan are necessary due to field conditions or unforeseen problems. The field supervisor also ensures that samples are handled, labeled, and shipped according to procedures outlined in the project Work Plan.

Field personnel are responsible for implementing this SOP as stated, and following the Work Plan requirements for sampling, QA/QC sample collection and frequency, and following other SOPs for field sample shipment and handling.

4.0 DEFINITIONS

Surface soil is generally considered to be the top 6 inches of a soil horizon profile (i.e., soil from 0-to-6-inches below ground surface [bgs]). Depending on the program or project, however, soil to 2 feet bgs may be considered surface soil. For the purposes of this procedure, surface soil represents the soil occurring from 0- to- 6-inches bgs.

Subsurface soil represents the soil occurring between surface soil and bedrock.

Composite soil samples are combinations of aliquots collected at various sample locations, or at various depths at a single location. Analysis of composite samples yields a value representing an average over the various sampled sites or depths from which individual samples were collected.

Discrete soil samples are discrete aliquots from distinct sampling intervals, of a specific size, that are representative of one specific sample location at a specific point in time.

Continuous samplers are devices that allow a soil specimen to enter a split barrel during drilling. Both plastic and steel liners can be used inside the sample tube to retain the sample. In some formations, the soil sample may be considered "undisturbed."

Split-barrel samplers collect samples by driving a 1.5-inch nominal inner diameter (typical), split barrel into a soil formation with a 140-pound hammer dropped 30 inches. For environmental applications, 2-, 2.5- and 3-inch inner diameter split barrels are not uncommon. If a standard 1.5-inch split barrel is used, the number of blows to drive the last 1 foot of the sample are referred to as the standard penetration resistance or N-value. See ASTM D-1586 for the specification for this type of sampler. Another type of split barrel sampler is the core barrel. A core barrel is longer and usually wider in diameter than the typical split barrel samplers and used on hollow stem auger drill rigs. Core barrels are usually 5 feet long and approximately 4-inch outside diameter, which sit into the leading auger and collect soil while drilling. Core barrels are typically unlined.

Ring-lined samplers are split barrels lined with removable rings. The rings are thin-walled and arranged in 1-, 2- or 6-inch increments to section the recovered soil sample. This device is used to collect soil samples for environmental applications and to collect relatively undisturbed soils in stiff and hard cohesive soils where it is not possible to push a sampler. See ASTM D3550 for the specification for this type of additional sampler.

Thin-walled tubes are used to recover relatively undisturbed soil samples by pressing the tubes into soil either hydraulically, or with a Denison or Pitcher sampler.

5.0 REQUIRED MATERIALS

Equipment used during manual collection of surface or subsurface soil samples may include a wide variety of tools depending upon the type of sampling and methods being used. This equipment can include, but is not limited to the following:

- Hand lens
- Stainless steel spoons/trowels and stainless steel hand augers

- Stainless steel split-spoon, split-barrel or continuous sampler
- Brass or stainless steel sampling sleeves, if applicable
- Encore™ Sampler T-bar and samplers (5 gram or 25 gram size), if applicable
- Field Balance accurate to 0.01 gram and VOA vials, and preservatives for field preservation of VOC vials under EPA 5035, if applicable
- Stainless steel bowls and pans, if applicable
- Silicon Tape, strapping tape, duct tape
- Field notebook or logbook
- Ball point pen
- Paper towels or Kimwipes
- Aluminum foil
- Teflon sheets
- Appropriate decontamination equipment
- Appropriate health and safety equipment
- Appropriate sample containers and labels, sample coolers and ice
- Chain of Custody forms
- Munsell soil color charts and grain size charts

6.0 PROCEDURE

This section identifies important preparations that should be made before initiating a soil sampling event and describes the steps that should be followed during soil sample collection at environmental sites.

Surface soil samples are defined in this procedure as samples collected from 0 to 6 inches below ground surface (bgs) or the first 2 inches of soil below a surficial layer of vegetation. These samples can be obtained easily using manual methods (i.e., a spade, trowel and scoop, or hand-auger). Surface soil samples can also be obtained with the assistance of a drilling rig equipped with a split-barrel sampler. The split-barrel sampler may be either unlined or lined with brass or stainless steel thin-wall sleeves.

Subsurface soil samples to be collected from depths greater than 6 inches bgs can be obtained manually using a hand-auger, a drilling rig, or excavating device (e.g., backhoe). A split-barrel sampler can be employed to depths in excess of 100 feet bgs with the assistance of a drilling rig. An excavating device can provide bulk soil samples from the ground surface to the limits of the excavator (typically 15 to 25 feet bgs . For bulk soil sampling at greater depths in unsaturated soils, a bucket auger rig may be used.

Composite soil samples are combinations of aliquots collected at various sample locations, or at various depths at a single location. Analysis of composite samples yields a value representing an average over the various sampled sites or depths from which individual samples were collected.

Composite soil sampling is typically used in sampling soil for the characterization of investigation derived waste for disposal purposes. Other uses of composite sampling is in characterization of large surface area where a material may have been distributed.

6.1 Preparation for Soil Sample Collection

Preparation for the field collection of surface and subsurface soil samples shall commence with an assessment of ground surface conditions (e.g., undeveloped, vegetated or not vegetated, paved or unpaved, type and thickness of any pavement present) and subsurface conditions (e.g., soil types present, degree of consolidation, moisture content, depth of groundwater). Information available to assess these conditions may include regional soil survey reports by the USDA Natural Resources Conservation Service and/or borehole or test-pit/trench logs maintained during previous geological, geotechnical, or environmental investigations.

If a point designated for soil sample collection is overlain by abundant vegetation, it may be necessary to clear the area before sampling to provide access. If the sampling point is overlaid with concrete pavement, it is necessary to arrange for a cement cutter/corer to remove the paving material prior to sampling (cement cutting services are available through construction support or drilling subcontractors).

Prior to field collection of soil samples, the Project Manager (PM), Task Manager (as appropriate), and field personnel shall also perform the following tasks.

- Conduct a general site reconnaissance in accordance with the site-specific safety and health plan.
- Mark or identify all sampling locations using stakes, markers, or flags. If required, a proposed sampling location may be adjusted based on access, property boundaries, surface obstructions, and subsurface utilities.
- Determine the extent of the monitoring and sampling effort, analytical methods to be requested for each sample, sample container types required, sampling methods to be used, and specific equipment and supplies necessary to conduct the monitoring and sampling.
- Prepare all field forms as appropriate (field logbooks, pre-prepared Chain of Custody records and labels, etc.)
- Determine required monitoring equipment (e.g., photoionization detector, vapor detection tubes) and personal protective equipment (PPE) required for the health and safety of personnel.
- Obtain the necessary sampling and monitoring equipment and ensure it is in working order.
- Prepare field sampling schedules, provide these schedules to the client (if required), subcontractors, and regulatory agencies (if required), and coordinate field sampling activities with their designated representatives.
- Perform an underground utility clearance of all staked sampling locations prior to excavating or drilling.

6.2 Manual Soil Sample Collection

The following sections describe the specific steps that the environmental engineer/geologist shall follow when collecting surface and subsurface soil samples.

6.2.1 Collection of Surface Soil Samples

Tools such as spades, shovels, trowels, scoops, or spoons can be used to collect most surface soil samples, however, the sampler should be certain the sampling tools are not made out of a material that may effect the sample results (e.g., galvanized metal should not be used to collect metals samples and plastic should not be used to collect semivolatile organic samples).

For densely packed soils, and to collect discrete surface soil samples, it may be necessary to use a hand auger (Section 6.2.2), or a drilling rig (Section 6.3). Also, if relatively undisturbed samples are required, a flat, pointed, mason trowel can be used to cut a block sample of the desired soil. The procedure is as follows:

1. Prior to beginning sampling, don clean disposable nitrile or latex surgical gloves and impervious outer gloves to prevent cross-contamination and to provide personal protection. New gloves should be donned for sample collection at each new location or whenever gloves are torn or otherwise compromised.
2. Carefully remove the top layer of vegetation, soil or debris to the desired sample depth with a decontaminated spade, shovel, or equivalent.
3. Using a decontaminated, stainless steel scoop, plastic spoon, or trowel, remove and discard a thin layer of soil from the area that came in contact with the spade. Also discard any pebbles, roots and other large objects that may be present in the sample material.
4. If a composite sample is required, place the sample into a stainless steel or other appropriate container and mix thoroughly to obtain a homogenous sample representative of the entire depth interval sampled. However, volatile organic samples are the exception; samples being analyzed for volatile organic compounds must be taken from discrete locations prior to mixing. This practice is necessary to prevent loss of volatile constituents and to preserve, to the extent practicable, the physical integrity of the volatile fraction. The process of homogenization is described below. After homogenization, place the sample into an appropriate container, as specified in the project Work Plan, and secure the cap tightly.
    - NOTE: If the sample is to be analyzed for volatile organic compounds (VOCs), transfer a portion of the sample directly (i.e., without homogenization) into the appropriate sample container with a stainless steel spoon, plastic spoon, or equivalent, and secure the container cap tightly. The sample container should be sealed with Teflon sheeting and capped with rubber caps in order to prevent VOCs from escaping. Alternatively, sampling using EPA Method 5035 may be used (Section 6.4).

- Place a sample from each sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into the appropriate sample container(s) and secure the cap tightly.

5. Homogenization of the sample for remaining parameters may be necessary to create a representative sample volume if sample heterogeneity is not being evaluated. Moisture content, sediments, and waste materials may inhibit the ability to achieve complete mixing prior to filling sample containers. Therefore, when homogenization is requested, it is extremely important that soil samples be mixed as thoroughly as possible to ensure that the sample is a representative as possible of the sample location. When homogenization is requested, the following procedure should be followed:

   - The soil is extruded from the sampling apparatus (i.e., drive sampler) or collected by a stainless steel trowel and emptied into the decontaminated stainless steel tray or bowl. Homogenization should be accomplished by then mixing with a decontaminated stainless steel or Teflon® instrument.

   - The method of choice for mixing is referred to as quartering and can be performed in a bowl or tray of an appropriate material (material depends on the parameters to be analyzed for). The soil in the sample pan is divided into quarters. Each quarter is mixed, then all quarters are mixed into the center of the pan. This procedure is followed several times until the sample is adequately mixed. If round bowls are used for sample mixing, adequate mixing is achieved by stirring the material in a circular fashion and occasionally turning the material over.

   - The extent of mixing required will depend on the nature of the sample and should be done to achieve a consistent physical appearance prior to filling sample containers.

   - Once mixing is completed, the sample should be divided in half and containers should be filled by scooping sample material alternatively from each half.

   - Potential Problems

     (1) The higher the moisture or clay content, the more difficult it is to homogenize the sample.

     (2) A true homogenization of soil, sediment, or sludge samples is almost impossible to accomplish under field conditions.

6. If a composite sample is not required, then the soil can be transferred directly into the sample containers. Attach a sample label to the container using the sample numbering system described in the Project Work Plan and the sample identification numbers generated for the specific locations.

7. Describe the sample following procedures outlined in the SOP for Soil and Rock Descriptions (SOP-12).

8. Record required field logbook and sample custody information as specified in the SOP for Field Documentation (SOP-03). Package the samples and prepare for transfer or shipment in accordance with the SOP for Sample Handling (SOP-01).

9. Mark the sample location with a numbered stake or other type of marker. If possible, photograph the sample location.
10. Sketch the sample location in the field logbook. If the proposed sampling point was relocated due to conditions encountered in the field, indicate both the original and actual sample locations on the site map, and record the reason for its relocation in the logbook.
11. Decontaminate sampling equipment in accordance with the SOP for Equipment Decontamination (SOP-05).
12. After a sampling round is complete, survey all sample locations to determine the ground surface elevation and horizontal coordinates, if required.

6.2.2 Soil Sampling with a Hand Auger

The equipment used for this manual method of soil sampling consists of an auger, a series of extensions, and a T-handle. The auger is used to bore a shallow hole to the desired sampling depth. The auger is then withdrawn, and the sample is collected by inserting a manual drive sampler (split-barrel) with brass or stainless steel sampler sleeves, and driving ahead of the auger hole. The typical sampler is a single shoe that contains one 6-inch sleeve or two 3-inch sleeves. Several types of hand augers are available, including tube, continuous-flight (screw), and posthole augers.

- With continuous-flight augers, the sample can be collected directly from the flights. Continuous-flight augers are satisfactory for use when a composite of the complete soil column is desired. This is not appropriate for depth discrete sampling.
- Posthole augers have limited utility for sample collection because they are designed to cut through fibrous, rooted, and/or swampy soils.

The following procedure is provided for manual collection of soil samples with a tube auger, as shown in Attachment A.

1. Don clean disposable nitrile or latex surgical gloves to prevent cross-contamination and to provide personal protection. New gloves should be donned for sample collection at each new location or whenever gloves are torn or otherwise compromised.
2. Check and clear each subsurface soil sample location prior to intrusive activities using as-built drawings, geophysical surveys (e.g. ground penetrating radar), or have clearances performed by the local utility company.
3. Clear the area to be sampled of any surface debris (e.g., twigs, rocks, litter). If a surface soil sample is to be collected, the environmental engineer/geologist shall follow the procedure for surface soils presented in Section 6.2.1. Before advancing the auger, it may be advisable to remove the first 3 to 6 inches of surface soil over a radius of approximately 6 inches around the borehole.
4. Attach the auger bit to a drill rod extension, and attach the T-handle to the drill rod.
5. Begin augering, periodically removing and depositing accumulated soils into an appropriate investigation-derived waste storage or transfer container. Temporary

storage on plastic sheeting is appropriate, if identified in a project Work Plan or Waste Management Plan.

6. After reaching the desired depth, slowly and carefully remove the auger from the borehole.
7. Decontaminate the split-barrel sampler and sleeves (if required) in accordance with the SOP for Equipment Decontamination (SOP-05). Place the decontaminated sampler sleeve(s) into the sampler barrel. The sampler barrels are generally 6 inches in length and can hold one 6-inch or two 3-inch sleeves. Assemble the sampler by aligning both sides of the barrel and then attaching the drive shoe and head to the barrel's bottom and top, respectively. Some drive samplers are a two-piece unit – the shoe, which contains the sleeve and the head. For these samplers, the head is aligned with the shoe and threaded onto the head. The impact driver is threaded onto the head. Extensions may be added between the impact driver and the sampler for depths greater than 2 feet.
8. If a lined soil sampler is to be used, decontaminate the sample sleeves and store decontaminated sample sleeves in aluminum foil or on clean plastic sheeting as project requirements dictate prior to assembling the split-barrel sampler.
9. Carefully lower the drive assembly into the borehole, then drive it until the sleeve(s) are advanced into the undisturbed soil below the borehole.
10. Retrieve the sampler from the borehole and disassemble it. Remove the sample from the unlined sampler and transfer it to the appropriate container(s) or remove the sleeve from the sampler, and submit each sample sleeve as stipulated in the Project Work Plan.
11. For sample sleeves, seal the ends of each sample sleeve with Teflon™ sheeting and tightly fitting plastic end caps. The end caps shall then be held in place with silicone tape or other U.S. EPA-approved sealing tape. Electrical or duct tape shall not be used.
12. For sampling using EPA Method 5035, samples may be collected directly from the middle or bottom sleeve with the EnCore™ sampler, or aliquots placed into VOA vials and preserved as discussed in Section 6.4.
13. If another sample is to be collected at a greater depth in the same borehole, reattach the auger bit to the drill and assembly, and follow the steps above. Decontaminate the auger between samples.
14. Attach a sample label(s) to the container(s) using the sample numbering system described in the Project Work Plan and the sample identification numbers generated for the specific locations.
15. Abandon the borehole according to applicable state, county, and local regulations and the SOP for Borehole Abandonment and Monitoring Well Destruction (SOP-08).
16. Follow Steps 7 through 12 of Section 6.2.1.

If vertical composite samples are desired, aliquots of soil should be collected at more than one sampling depth and placed in a single collection container prior to mixing. Mixing is then performed using the procedures outlined in the surface soil composition section (Section 6.2).

6.3 Subsurface Soil Sampling with a Drilling Rig

Most often, when subsurface soil sampling is required at depths exceeding 5 feet bgs, a drilling subcontractor is used to help obtain the samples. Several drilling methods may be employed to collect the samples. Regardless of the drilling method, a 2-inch or 2.5-inch internal diameter split-barrel sampler (Attachment B) is often used to collect samples at depth. The split barrel sampler is attached to the appropriate drive-weight assembly, is positioned at the desired sampling depth and driven by repeated blows of a 140-pound hammer with a free-fall of 30 inches in general accordance with ASTM D1586 or with a pneumatic air hammer. Generally, split-barrel samples are 18 inches in length, but longer samples are also available.

Soil samples to be submitted to an analytical laboratory for testing may be collected in an unlined split-barrel sampler and transferred to sample containers as appropriate for shipment to the laboratory. However, the preferable method is to collect soil samples using a split-barrel sampler lined with thin-wall brass or stainless steel sleeves. This method allows for the collection of samples for chemical and physical properties or geotechnical analysis. Soil samples to be analyzed for metals shall be collected in stainless steel sleeves. Six-inch, 3-inch, or combinations of both sizes of sleeves can be used to line the split-barrel sampler. The procedures are outlined in the following sections.

Some of the procedures included in the following subsections are performed by the drilling subcontractor. Any procedure that deals with the apparatus (e.g. drill rig, split barrel samplers, drill rods) and services (e.g. drilling the boring and collection of soil samples) provided by the drilling subcontractor is operated by that subcontractor, who is qualified to do so.

6.3.1 Split-barrel sampler

1. Don clean disposable surgical nitrile or latex gloves to prevent cross-contamination and to provide personal protection. New gloves should be donned for sample collection at each new location or whenever gloves are torn or otherwise compromised.
2. Clear the ground surface of any surface debris (e.g., twigs, rocks, litter) or pavement prior to initiating drilling and sampling operations.
3. Decontaminate the split-barrel sampler and sleeves in accordance with the SOP for Equipment Decontamination.
4. Place the decontaminated sampler sleeve(s) into the sampler barrel. Assemble the sampler by aligning both sides of the barrel and then attaching the drive shoe and head to the barrel's bottom and top, respectively.
5. Attach the soil sampler to the drill rod assembly and advance it 18 inches bgs or the total length of the sampler.
6. Retrieve the sampler from the borehole and disassemble it. Remove the bottom 6 inches of the sample from the unlined sampler and transfer it to the appropriate containers. If sample sleeves are used and full recovery is achieved, typically, the middle sleeve shall constitute the soil sample for analytical analysis. The ends of the middle sleeve should be quickly noted for lithological descriptions, the sample prepared for shipment and the remaining soil from the remaining sleeves used to

describe the soil for that drive interval. The sleeve used for analytical analysis is dependent on the purpose of the sampling. Consult the PM for direction. If the soil is the litholgically the same throughout the interval, the less disturbed sample should be used for analytical analysis. The number of sleeves to be sent depends upon project analytical requirements. The top sleeve or top portion of the sampler is often material that has fallen back in the borehole and is not characteristic of the sample depth. If inadequate sample recovery is obtained, use material from the bottom sleeve first, followed by whatever material is in other sleeves, or attempt to recollect the sample. Sleeve samples shall also be packaged and handled in accordance with the SOP for Sample Handling.

7. When collecting subsurface soil samples, advance the drill bit and rod assembly to the top of the next desired sampling interval. After removing any excess cuttings from the borehole and tripping the drill bit out of the borehole, attach the empty decontaminated soil sampler to the drill rod assembly and lower it into the borehole.
8. Mark the drill rods in successive 6-inch increments so that the advance of the soil sampler can be easily observed by the environmental engineer/geologist. Advance the split-barrel sampler the required distance (generally 18 inches) with blows from the hammer.
9. Count the number of blows applied for each 6-inch increment of sampler advance into subsurface soils and record this information on the borehole log in accordance with the SOP for Field Documentation and Borehole Logging. Sampler refusal is generally indicated if more than 50 blows are required to advance the sampler 6 inches.
10. If an orientated geotechnical sample is required, mark each of the sample sleeves, if used, with a “T” and a “B,” using a wax crayon or a pen with indelible ink, to indicate stratigraphic “top” and “bottom,” respectively. Log the exposed soil at the ends of each sample sleeve other than the lowest in accordance with the SOP for Borehole Logging.
11. Without disturbing the sample, seal the ends of each sample sleeve with Teflon sheeting and tightly fitting plastic end caps. The end caps may then be held in place with silicone tape.
12. If another soil sample is to be collected at a greater depth in the same borehole, drill to the desired depth, reattach the split-barrel sampler to the drill rod assembly, and follow Steps 5 through 8 above. Be sure to decontaminate the sampler between samples.
13. Label sample sleeves using the sample numbering system described in the Project Work Plan and the sample identification numbers generated for the specific locations. The sample identification number for split-barrel samples shall include the sample depth, accounting for the appropriate incremental depth based on the location of the sleeve within the split-barrel sampler. Record other required field logbook information as specified in the SOP for Field Documentation.
14. Follow Steps 15 and 16 of Section 6.2.2.

6.3.2 Continuous sampler (Physical characterization only – not for analytical sampling)

1. Don clean, disposable nitrile or latex surgical gloves to prevent cross-contamination and provide personal protection. New gloves will be donned for sample collection at each location, or whenever gloves are torn or otherwise compromised.
2. Using the drilling equipment (e.g., hollow stem augers), advance the soil boring to the depth immediately above the sampling interval.
3. Attach the continuous sampler to the rods or cable and insert into the hollow-stem augers (or casing) and lower it to the bottom of the borehole.
4. Advance the sampler ahead of the augers into the undisturbed sampling interval.
5. Retrieve and split open the sampler.
6. Log the samples in accordance with the SOP for Borehole Logging.

6.4 Field Sampling Using EPA 5035

Collection and storage of soils for VOC analysis using current US EPA methodology has changed since the promulgation of SW846 Method 5035. The EnCore™ Sampler is one of three collection options promulgated from the change in SW846 Method 5035. The other two collections are Acid Preservation and Methanol Preservation. The other two methods are employed only if field constraints are such that samples cannot be shipped and received by a laboratory within 24 to 36 hours of sampling. EPA Method 5035 calls for the preservation of samples if analysis cannot occur within 48 hours. To allow adequate time for the laboratory to preserve the samples if necessary, the laboratory should receive them within 24 to 36 hours of collection. This section describes the proper procedures and methods to be employed in the collection and shipment of soil samples collected under EPA Method 5035.

Innovative Technologies (1-888-411-0757) is at this time the only supplier of the Encore™ sampler. Detailed information from Innovative Technologies about the Encore sampler™ is provided in Attachment C.

6.4.1 Collection of samples for Low Level Analyses (> 1 µg/kg)

Each sample point requires two 5g samplers, one 25g sampler or one 5g sampler for screening and/or high level analysis, one dry weight cup, one T-handle and paper towels. The number of samplers required may be different from these typical numbers based on the QAPP requirements for the project. The Project chemist should be consulted in determining the number of Encore™ samplers required for the project. The procedure is as follows:

1. Remove sampler and cap from package and attach T-handle to sampler body. Make sure that the sampler is locked into place in the T-handle.
2. Quickly push sampler into a freshly exposed surface of soil until the sampler is full. The sampler is full when the o-ring is visible in the hole on the side of the T-handle.
3. Use paper towel to quickly wipe the sampler head so that the cap can be tightly attached.
4. Push cap on with a twisting motion to attach cap.

5. Place sampler into the package.
6. Fill out label and attach to the package, where specified for the label..
7. Repeat procedure for the other two samplers.
8. Collect dry weight sample – fill container. If other samples (non-Encore™) are collected for the same sampling interval, the dry weight sample may be designated and analyzed using the other sample.
9. Store samplers at 4 degrees Celsius.
10. Ship sample containers with plenty of ice to the laboratory. Samples must arrive at the laboratory **within 40 hours** of collection.

6.4.2 Acid Preservation Sampling for Low Level Analyses (> 1 µg/kg)

This procedure should be done in the field only if field constraints prevent shipment to the laboratory such that the laboratory cannot perform the analysis within 48 hours (or samples will not arrive within 24 to 36 hours of collection).

Each sample point requires the following equipment:

- One 40ml VOA vial with acid preservative (for field testing of soil pH).
- Two pre-weighted 40ml VOA vials with acid preservative and stir bar (for lab analysis).
- Two pre-weighted 40 ml VOA vials with water and stir bar (in case samples effervesces).
- One pre-weighted jar that contains methanol or a pre-weighted empty jar accompanied with a pre-weighted vial that contains methanol (for screening sample and/or high level analysis).
- One dry weight cup.
- One 2 oz jar with NaHSO4 acid preservative (in case additional acid is needed due to high soil pH).
- One scoop capable to deliver about one gram of solid sodium bisulfate.
- pH paper.
- Weighing balance that weighs to 0.01 gram (filed balances may not reliably weigh to 0.01 gram).
- Set of balance weights used in daily balance calibration.
- Gloves for working with pre-weighted sample vials.

The field chemistry procedure for testing effervescing capacity of soils is as follows:

1. Place 5 grams of soil into vial that contains acid preservative and no stir bar.

2. Do not cap this vial as it may EXPLODE upon interaction with the soil.
3. Observe the sample for gas evolution (due to carbonates in the soil).
4. If vigorous or sustained gas evolution occurs, then acid preservation is not acceptable to preserve the sample. In this case, the samples need to be collected in the VOA vials with only water and a stir bar. The vials with acid preservative CANNOT be used.
5. If a small amount or no gas evolution occurs, then acid preservation is acceptable to preserve the sample. Keep this testing vial for use in the buffering testing detailed below. In this case, the samples need to be collected in the VOA vials with the acid preservative and a stir bar.

The field chemistry procedure for testing buffering capacity of soils is as follows:

1. If acid preservation is acceptable for sampling soils than the sample vial that was used in the effervescing testing can be used here for testing the buffering capacity of the soil.
2. Cap the vial that contains 5 grams of soil, acid preservative and no stir bar from Step #1 in the effervescing testing.
3. Shake the vial gently to attempt to make a homogenous solution.
4. When done, open the vial and check the pH of the acid solution with the pH paper.
5. If the pH paper reads below 2 then the sampling can be conducted in the two pre-weighted 40 ml VOA vials with the acid preservative and stir bar. Since the pH was below 2, it is not necessary to add additional acid to the vials.
6. If the pH paper reads above 2, then additional acid needs to be added to the sample.
7. Use the jar with the solid sodium bisulfate acid and add another gram of acid to the sample.
8. Cap the vial and shake thoroughly again.
9. When done, open the vial and check the pH of the acid solution with a new piece of pH paper.
10. If the pH paper reads below 2 then the sampling can be conducted in the two pre-weighted 40 ml VOA vials with the acid preservative and stir bar and one extra gram of acid.
11. Make a note of the extra gram of acid needed so the same amount of extra acid can be added to the vials the lab will analyze.
12. If the pH paper reads above 2, then add another gram of acid and repeat this procedure one more time.

The procedure for collection of samples is as follows:

1. Wear gloves during all handling of pre-weighed vials.
2. Quickly collect a 5 gram sample using a cut off plastic syringe or other coring device designed to deliver 5 grams of soil from a freshly exposed surface of soil.
3. Carefully wipe exterior of sample collection device with clean paper towel.
4. Quickly transfer to the appropriate VOA vial, extruding with caution so that the solution does not splash out of the vial.
5. Add more acid if necessary (this is based on the buffering testing discussed on the previous section).
6. Use the paper towel and quickly remove any soil off of the vial threads.
7. Cap vial and weigh the jar to the nearest 0.01 gram.
8. Record exact weight on the sample label.
9. Repeat sampling procedure for the duplicate VOA vial.
10. Collect dry weight sample – fill container.
11. Store samples at 4 degrees Celsius.
12. Ship containers with plenty of ice and per DOT regulations to the laboratory.

6.4.3 Encore™ Sampler Collection For High Level Analyses (> 200 µg/kg)

Each sample point requires the following equipment:

- One 25g sampler or one 5g sampler. (The sampler size used will be dependent on who is doing the sampling and who is doing the laboratory analysis).
- One dry weight cup.
- One T-handle.
- Paper towels.

The procedure for collecting soil samples is as follows:

1. Remove sampler and cap from package and attach T-handle to sampler body. Make sure that the sampler is locked into place in the T-handle.
2. Quickly push sampler into a freshly exposed surface of soil until the sampler is full. The sampler is full when the o-ring is visible in the hole on the side of the T-handle.
3. Use paper towel to quickly wipe the sampler head so that the cap can be tightly attached.
4. Push cap on with a twisting motion to attach cap.
5. Place sampler into the package.

6. Fill out label and attach to the package, where specified for the label.
7. Collect dry weight sample – fill container. If other samples (non-Encore™) are collected for the same sampling interval, the dry weight sample may be designated and analyzed using the other sample.
8. Store samplers at 4 degrees Celsius.
9. Ship sample containers with plenty of ice to the laboratory. Samples must arrive at the laboratory **within 40 hours** of collection.

6.4.4 Methanol Preservation Sampling for High Level Analyses (> 200 µg/kg)

This procedure should be done in the field only if field constraints prevent shipment to the laboratory such that the laboratory cannot perform the analysis within 48 hours (or samples will not arrive within 24 to 36 hours of collection).

Methanol preservation of each sample point requires the following equipment:

- One pre-weighted jar that contains methanol or a pre-weighted empty jar accompanied with a pre-weighted vial that contains methanol.
- One dry weight cup.
- Weighing balance that weighs to 0.01 gram (filed balances may not reliably weigh to 0.01 gram).
- Set of balance weights used in daily balance calibration.
- Gloves for working with pre-weighted sample vials.
- Paper towels.

The procedure for collection of soil samples is as follows:

1. Wear gloves during all handling of pre-weighed vials.
2. Weigh the vial with methanol preservative in it to 0.01 gram. If the weight of the vial with methanol varies by more than 0.01 gram from the original weight recorded on the vial - discard the vial. If the weight is within tolerance it can be used for soil preservation below.
3. Tare the empty jar or the jar that contains the methanol preservative.
4. Quickly collect a 25 gram or 5 gram sample using a cutoff plastic syringe or other coring device designed to deliver 25 gram or 5 gram of soil from a freshly exposed surface of soil. The 25 gram or 5 gram is dependent on who is doing the sampling and who is doing the laboratory analysis.
5. Carefully wipe the exterior of the collection device with clean papa towel.
6. Quickly transfer the soil to an empty soil jar that contains methanol. If extruding into a jar that contains methanol be careful not splash the methanol outside of the vial. Again, the type of jar received is dependent on who is doing the laboratory analysis.

7. If the jar used to collect the soil plug was empty before the soil was added, immediately preserve with the methanol provided – using only one vial of methanol preservative per sample jar.
8. Use the paper towel and remove any soil off of the vial treads and cap the jar.
9. Weigh the jar with the soil in it to 0.10 gram and record the weight on the sample label.
10. Collect dry weight sample – fill container.
11. Store samples at 4 degrees Celsius.
12. Ship containers with plenty of ice and per DOT regulation to the laboratory.

6.5 Bulk Soil Sampling

Large volumes of soil are generally not required for environmental investigations. However, soil samples may be collected in bulk with a backhoe from test-pits or trenches to a maximum depth of approximately 15 to 25 feet . A bucket auger may be used to collect bulk soil samples to maximum depths of 250 feet if the soils are unsaturated.

If bulk sampling is required for a given project, the procedure for sample collection will be provided in the project Work Plan. In general, any bulk sampling conducted on a project will follow the procedures discussed under the sections above. Whether samples will be composited into stainless steel bowls, collected under EPA 5035, or into sample sleeves will be determined and described in the project Work Plan.

7.0 QUALITY ASSURANCE/QUALITY CONTROL

In order to assess the accuracy and precision of the field methods and laboratory analytical procedures, quality assurance/quality control (QA/QC) surface and subsurface soil samples are collected during the sampling program according to the project Work Plan. QA/QC samples may be labeled with QA/QC identification numbers or fictitious identification numbers if blind submittal is desired, and are sent to the laboratory with the other samples for analyses. The frequency, types, and locations of QA/QC samples are specified in the project Work Plan. Examples of QA samples are equipment rinsate samples, duplicate samples, matrix spike/matrix spike duplicate samples, performance evaluation samples, and laboratory blind duplicate samples.

7.1 Equipment Rinsate Samples

An equipment rinsate sample is intended to check if decontamination procedures have been effective and to assess potential contamination resulting from containers, preservatives, sample handling and laboratory analysis. Procedures for collection are as follows:

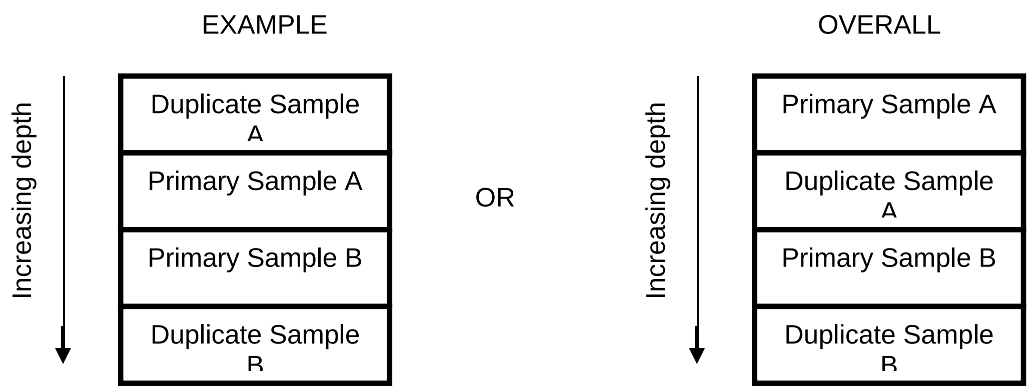
1. Rinse the decontaminated sampling apparatus with deionized water. Allow the rinsate to drain from the sampling apparatus directly into the sample bottle.

2. Add any preservatives associated with the soil sample analytical methods to the rinsate sample.
3. Specify (on the COC) the same analytical methods for rinsate samples as is specified for the soil samples.
4. For validation reasons, assign the rinsate sample an identification number and label as rinsate samples, not as blanks.
5. Place the rinsate sample in a chilled cooler and ship it to the laboratory with the other samples.

7.2 Duplicate Samples

Duplicate samples are collected to assess the precision of field and laboratory components of field samples and matrix heterogeneity. Duplicate samples are similar to split samples and should be collected like split samples. Project specifications will determine if the duplicate samples are homogenized. If so, proceed with the instructions for homogenization in Section 6.2.1. Otherwise, the collection of duplicate samples will be collected in the next consecutive sample. For example, if a 18-inch long split barrel contains three 6-inch long full sleeves of soil. The middle sleeve is designated as the primary sample, then the next sleeve, either the top or bottom sleeve must be the duplicate sample.

The collection of duplicate samples is more complex, when more sleeves are needed for analyses. For example, for the same split barrel and three full sleeves of soil, two sleeves are necessary for the primary analyses (i.e. A and B). In this scenario the duplicate is the next sleeve. The middle sleeve can be designated as Primary Sample A, the top sleeve as the duplicate for Primary Sample A and the third sleeve as Primary Sample B. The duplicate for Primary Sample B must be collected from the top sleeve in the next split barrel, which means the sampler must be driven again into the soil from the point where the last sampler stopped. The example and the overall relationship of collection of the primary and duplicate soil samples are illustrated below.



To maximize the information available in assessing total precision, collect duplicate samples from locations suspected of the highest contaminant concentration. Use field measurements (such as HNu data) or visual observations, past sampling results, and historical information to select appropriate locations for duplicate analyses.

The duplicate sample is handled and preserved in the same manner as the primary sample and assigned a sample number, stored in a chilled cooler, and shipped to the laboratory with the other samples. Whenever possible, the sample identification numbers for the characteristic sample and its duplicate are independent such that the receiving laboratory is not able to distinguish which samples are duplicates prior to analysis.

7.3 Matrix Spike/Matrix Spike Duplicate Samples

An extra volume of sample media may be collected during the sampling event for performance of matrix spike (MS)/matrix spike duplicate (MSD) analyses by the laboratory to assess laboratory accuracy, precision, and matrix interference. Following shipment of the samples to the laboratory, the laboratory prepares MS and MSD samples by homogenizing the soil matrix collected in the field and splitting the material into three separate sets of containers. Note that sample aliquots for volatile analysis are not homogenized. The laboratory spikes the split samples with appropriate analytes prior to performing the extraction in order to evaluate the total of the spiked compound and whatever quantity of the compound may be present in the sample. Results of the analyses are compared with the results of the primary sample and the known concentrations of the spike compounds. The percent recovery and relative percent difference are calculated and results are used to evaluate the precision and accuracy of the analytical method for various labeled "extra volume samples for MS/MSD." The sample volumes required for these analyses should be coordinated with the laboratory and are described in the project Work Plan.

7.4 Performance Evaluation Samples

Performance evaluation or pre-spiked soil samples may be used to assess laboratory extraction efficiency and accuracy in constituent identification and quantification. Because these samples are helpful in assessing the potential bias of analytical methods, they are also commonly used to evaluate the accuracy of non-standard methods or mobile laboratory procedures. These samples are generally prepared by an independent laboratory and shipped in pre-sealed containers to the field to be included with the samples sent to the laboratory performing the analysis of site soil samples. As for field blanks, these spiked samples are generally limited to organic constituents. The analytes of interest and corresponding analyte concentrations for the spike samples must be specified in the request to the independent laboratory providing the samples in accordance with the project Work Plan. These samples are assigned an identification number, stored in a chilled cooler, and shipped blind to the laboratory with the other samples.

7.5 Laboratory Blind Duplicate Samples

If appropriate, or required by program Quality Assurance, laboratory blind duplicate samples may also be used to assess laboratory accuracy in constituent identification and quantification. Laboratory blind duplicate samples consist of two or more representative sample volumes from one heterogeneous soil sample obtained from one sampling location. Equal volumes of representative aliquots from the mixture are submitted to two or more laboratories for analysis. The results of each laboratory are compared as a check on the laboratory accuracy. Because two samples are analyzed, environmental variability and precision (from one location to another) are included in this assessment.

The laboratory blind duplicate sample volume collected by the sampling team is preserved, packaged and submitted for analysis in the same manner as the other characteristic samples in accordance with the project Work Plan.

7.6 Other Sample Types

Ambient or background samples are used to assess the range of concentrations of potential contaminants and naturally occurring inorganic compounds in the vicinity of the site which are not the result of site activities. These samples are collected from areas not believed impacted by historical site operations (i.e., away from source areas and upwind).

The ambient or background samples are collected at the locations and depths specified in the project Work Plan. If the locations are not specified, a nearby park or other area void of industrial activity, for example, may be suitable for collection of ambient samples. The soil type should be as close as possible to the onsite characteristic samples. If appropriate, information can be obtained from various state and local agencies (e.g. USDA Natural Resources Conservation Service) that could aid in selection of ambient soil sampling locations. Ambient soil samples should be collected following the same procedure as that used for the onsite soil samples.

8.0 REFERENCES

U.S. Environmental Protection Agency, A Compendium of Superfund Field Operations Methods, EPA/540/P-87/001, December 1987.

U.S. Environmental Protection Agency, Compendium of ERT Soil Sampling and Surface Geophysics Procedures, EPA/540/
P-91/006, Interim Final, January 1991.

U.S. Environmental Protection Agency, Description and Sampling of Contaminated Soils - A Field Pocket Guide, EPA/625/P-12-91/902, November 1991.

American Society for Testing Materials, Annual Book of ASTM Standards, Section 4, Volume 4.08, Practice for Soil Investigation and Sampling by Auger Borings, ASTM D 1452-80 (1990), 1992.

American Society for Testing Materials, Annual Book of ASTM Standards, Section 4, Volume 4.08, Standard Method for Penetration Test and Split-Barrel Sampling of Soils, ASTM D 1586-84, 1992.

American Society for Testing Materials, Annual Book of ASTM Standards, Section 4, Volume 4.08, Standard Practice for Thin-walled Tube Sampling of Soils, ASTM D 1587-88, 1992.

American Society for Testing Materials, Annual Book of ASTM Standards, Section 4, Volume 4.08, Practice for Ring-Lined Barrel Sampling of Soils, ASTM D 3550-84 (1991), 1992.

American Society for Testing Materials, Annual Book of ASTM Standards, Section 4, Volume 4.08, Standard Practice for Preserving and Transporting Soil Samples, ASTM D 4220-89, 1992.

En Novative Technologies, Inc., SW846 Method 5035 Field Sampling Guide, February 1998.

9.0 ATTACHMENTS

None

SOP-12
Field Classification and Description of Soils and Rock

Yerington Mine Site
Standard Operating Procedure

Revision 0
Revision Date: June 6, 2006

SOP-12
FIELD CLASSIFICATION AND DESCRIPTION OF SOILS AND ROCK

TABLE OF CONTENTS

1.0 OBJECTIVES

This objective of this Standard Operating Procedure (SOP) is to establish a consistent method for field staff to follow when completing the description of soil and rock samples obtained from field sampling efforts and entry into borehole logs. Consistency with description is important because during many projects multiple employees may be involved at different times. Hence, being able to compare between logs that were created by different geologists is essential for creating subsurface interpretations.

2.0 SCOPE AND APPLICABILITY

This procedure will be used during all field activities when bore hole subsurface drilling, surface soil or rock sampling, reconnaissance geological mapping is occurring. These activities should be documented as described herein, and following the SOP for Field Notes and Documentation (SOP-03).

3.0 RESPONSIBILITIES

The *Project Manager (PM)* shall ensure that the soil or rock classification and description procedures used in the field conform to the guidelines in this SOP. The PM shall ensure that all field personnel providing descriptions are properly trained to conduct this task and are providing descriptions under the oversight of a Senior Geologist registered in the state in which the logging is occurring. If the state does not have requirements for registration, then the Senior Geologist should meet the standards for a professional geologist under that states law or be registered in another state.

The *Field Supervisor* is responsible for reviewing lithologic logs for accuracy and completeness prior to releasing them to the project manager for review.

The *Field Geologist* is responsible for following the soil classification and description procedures in this SOP, and for accurately and completely representing the lithology encountered in the field

4.0 DEFINITIONS

ASTM. American Society for Testing Materials.

Feldspathoids. Alkali (potassium) or basic (plagioclase) feldspar.

IUSG. International Union of Geological Sciences

USCS. Unified Soil Classification System.

5.0 MATERIALS REQUIRED

The materials required for completing the procedures outlined in this SOP, at a minimum, include the following:

- Hand lens
- Field notebook and borehole log forms
- Protractor

- Pencils
- Pocket knife
- Dilute hydrochloric acid in small dispenser
- Field charts of grain size examples (e.g., American Geological Institute [AGI] data sheets)
- Squirt bottle with water
- Compass with altimeter

6.0 METHODS

The following sections provide guidance for how proper field visual descriptions of soils and rock samples should be conducted. These methods may not be applicable to every soil or rock sample found, but should provide enough guidance to allow accurate and defensible descriptions by a variety of field geologists.

6.1 DESCRIPTION OF SOILS

The following section provides a description of the procedures that should be used when describing soils.

6.1.1 General Considerations

The most popular soil classification method that is based on grain size and other properties, is the Unified Soil Classification System (USCS). This system was initially developed by A. Casagrande in 1948 and was then called the Airfield Classification System. It was adopted with minor modifications by the U.S. Bureau of Reclamation and the U.S. Corps of Engineers in 1952. In 1969, the American Society for Testing and Materials (ASTM) adopted the system. This system is designated currently by ASTM as D-2488-90 and will be used as a guideline for classifying and describing lithology. It requires certain information (e.g. liquid limit, plastic limit moisture content and plasticity index) about the soil which can only be obtained in a laboratory.

The USCS is based on grain size and response to physical manipulation at various water contents. This system is often used for classifying soils encountered in boreholes, test pits, and surface sampling. The following properties form the basis of USCS soil classification:

- Percentage of gravel, sand, and fines;
- Shape of the grain size distribution curve; and
- Plasticity and compressibility characteristics.

Four soil fractions are recognized. They are cobbles, gravel, sand, and fines (silt or clay). The soils are divided as coarse grained soils, fine grained soils, and highly organic soils. The coarse grained soils contain 50 percent of grains coarser than a number 200 sieve (approximately 0.08 mm). Fine grained soils contain more than 50 percent of material smaller than the number 200 sieve. Organic soils contain particles of leaves, roots, peat, etc.

6.1.2 Soil Description Procedures

The following will be used as a guideline for logging lithology from subsurface activities (i.e. borehole drilling, trenching, etc.).

The USCS recognizes 15 soil groups and uses names and letter symbols to distinguish between these groups. The coarse grained soils are subdivided into gravels (G) and sands (S). Both the gravel and sand groups are divided into four secondary groups. Fine grained soils are subdivided into silts (M) and clays (C).

Soils are also classified according to their plasticity and grading. Plastic soils are able to change shape under the influence of applied stress and to retain the shape once the stress is removed. Soils are referred to either low (L) or high (H) plasticity. The grading of a soil sample refers to the particle size distribution of the sample. A well graded (W) sand or gravel has a wide range of particle sizes and substantial amounts of particles sized between the coarsest and finest grains. A poorly graded (P) sand or gravel consists predominately of one size or has a wide range of sizes with some intermediate sizes missing.

Soils which have characteristics of two groups are given boundary classifications using the names that most nearly describe the soil. The two groups are separated by a slash. The same is true when a soil could be well or poorly graded. Again the two groups are separated by a slash.

Soil description should be concise and stress major constituents and characteristics for fine-grained, organic, or coarse-grained soils. Tables 1 and 2 are checklists for descriptions of fine-grained, organic soils, and coarse-grained soils, respectively. Field descriptions should include as a minimum:

> <u>Soil name</u>. The basic name of the predominant constituent and a single-word modifier indicating the major subordinate constituent.
>
> <u>Particle Size Distribution</u>. An estimate of the percentage and grain-size range of each of the soil's subordinate constituents with emphasis on clay-particle constituents. This description may also include a description of angularity. This parameter is critical for assessing hydrogeology of the site and should be carefully and fully documented.
>
> <u>Gradation or Plasticity</u>. For granular soil (sands or gravels) that should be described as well-graded, poorly graded, uniform, or gap-graded, depending on the gradation of the minus 3-inch fraction. Cohesive soil (silts or clays) should be described as non-plastic, low plastic, medium plastic, or highly plastic.
>
> <u>Dry Strength</u>. Dry strength describes the crushing characteristics of a dry soil crumb about ¼ inch (5 mm) in diameter. If a crumb of dry soil is not available, after removing particles larger than No. 40 sieve size, mold at least three balls of soil about ¼ inch (5 mm) in diameter to the consistency of putty, adding water if necessary. Allow the balls to dry completely by oven, sun, or air drying, and then test their strength by breaking and crumbling between the fingers. This strength is a measure of the character and quantity of the colloidal fraction contained in the soil. The dry strength increases with increasing plasticity.
>
> <u>Dilatancy</u>. Dilatancy describes the soils reaction to shaking. After removing particles larger than No. 40 sieve size, prepare a ball of moist soil about ½ inch (15 mm) in diameter. Add

enough water, if necessary, to make the soil soft but not sticky. Place the ball in the open palm of one hand and shake horizontally, striking vigorously against the other hand several times. A positive reaction consists of the appearance of water on the surface of the ball which changes to a livery consistency and becomes glossy. When the sample is squeezed between the fingers, the water and gloss disappear from the surface, the ball stiffens, and finally cracks or crumbles. The rapidity of appearance of water during shaking and of its disappearance during squeezing assist in identifying the character of the fines in a soil.

Toughness. Toughness is the consistency of the soil near the plastic limit. After removing particles larger than the No. 40 sieve size, mold a ball of soil about ½ inch (15 mm) in diameter to the consistency of putty. If too dry, water must be added and if sticky, the specimen should be spread out in a thin layer and allowed to lose some moisture by evaporation. The specimen is then rolled out by hand on a smooth surface or between the palms into a thread about 1/8 inch (3 mm) in diameter. The thread is folded and rerolled repeatedly. During this manipulation, the moisture content is gradually reduced and the specimen stiffens, finally loses it plasticity, and crumbles when the plastic limit is reached.

Color. The basic color of the soil (refer to Munsell soil color charts).

Odor. Odor is described from a warm, moist sample. The odor should only be described if it is organic or unusual. An organic odor will have distinctive decaying vegetation smell. Unusual odors, petroleum product, chemical, and the like should be described.

Soil Texture and Structure. Description of particle size distribution, arrangement of particles into aggregates, and their structure. This description includes joints, fissures, slicked sides, bedding, veins, root holes, debris, organic content, and residual or relict structure, as well as other characteristics that may influence the movement or retention of water or contaminants.

Moisture Content. The amount of soil moisture described as dry, moist, or wet/saturated.

Relative Density or Consistency. An estimate of density of a fine-grained soil or consistency of a cohesive soil, usually based on standard penetration tests.

Cementation. An estimate of cementation of a coarse-grained soil.

Relative Permeability. An estimate of the permeability based on visual examination of materials (e.g., high permeability for course sand and gravel verses low permeability for silty clay). The estimate should address presence and condition of fractures (open, iron-stand, calcite-filled, open but claylined, etc.), as well as fracture density and orientation;

Local Geologic Name. Any specific local name or generic name (i.e., alluvium, loess).

Group Symbol. USCS of symbols.

The soil logs should also include a complete description of any tests run in the borehole; placement and construction details of piezometers, wells, and other monitoring equipment; abandonment records; geophysical logging techniques used; and notes on readings obtained by air monitoring instruments.

The following tables outline the criteria used for determining the descriptive classification of soils based on simple field tests.

Criteria for Describing Plasticity

Descriptive item	Criteria
Nonplastic	A 1/8 inch (3 mm) thread cannot be rolled at any moisture content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times close to the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

Criteria for Describing Dry Strength

Descriptive item	Criteria
None	The dry specimen crumbles into powder with mere pressure of handling
Low	The dry specimen crumbles into powder with some finger pressure.
Medium	The dry specimen breaks into pieces and crumbles with considerable finger pressure.
High	The dry specimen cannot be broken with finger pressure. Specimen will break into pieces between thumb and a hard surface.
Very high	The dry specimen cannot be broken between the thumb and a hard surface.

Criteria for Describing Dilatancy

Descriptive item	Criteria
None	No visible change in the specimen
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear, or disappears slowly upon squeezing.
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing.

Criteria for Describing Toughness

Descriptive item	Criteria
Low	Only slight pressure is required to roll the thread near the plastic limit. The thread and lump are weak and soft.
Medium	Medium pressure is required to roll the thread to near the plastic limit. The lump and thread have medium stiffness
High	Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump have very high stiffness.

Criteria for Describing Moisture

Descriptive item	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet/saturated	Visible free water, usually soil is below water table.

Structure (for description of soils only)

Descriptive item	Criteria
Stratified	Alternating layers of varying material or color with layers at least 6 mm (1/4 inch) thick; note thickness
Laminated	Alternating layers of varying material or color with layers less than 6 mm (1/4 inch) thick; note thickness.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear polished or glossy, sometimes striated (parallel grooves or scratches)
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown.
Lensed	Inclusion of small lenses of sand scattered through a mass of clay; note thickness.
Homogeneous	Same color and appearance throughout.

Criteria for Describing Consistency

Descriptive item	Criteria
Very soft	Thumb penetrates soil more than 1 inch
Soft	Thumb penetrates about 1 inch
Firm	Thumb indentation up to ¼ inch
Hard	No indentation with thumb, readily indented with thumbnail
Very Hard	Not indented with thumbnail

Criteria for Describing Cementation

Descriptive item	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

6.2 DESCRIPTION OF ROCK

The following section provides a description of the procedures that should be used when describing rock samples.

6.2.1 General Considerations

Rock identification is based on minerals and textures. Drilling in rock will be slow and core recovery may consist of pulverized chips. The proper drilling technique is necessary for adequate recovery and accurate rock identification.

6.2.2 Rock Description Procedures

Rocks can be categorized into three types: sedimentary, igneous, and metamorphic. Descriptions for these three types of rocks are different. The following procedures are organized following the three categories.

***Sedimentary Rock Classification*.**

Sedimentary rocks result from two processes (and combinations thereof):

- Consolidation of loose sediments that have accumulated in layers, forming *clastic rocks*.
- Precipitation from solution to form a *chemical rock*. Included in this category are rocks directly or indirectly formed by biological processes.

The following text summarizes how to characterize these two types of sedimentary rock.

Clastic Rocks. Clastic rocks have been classified different ways. They may be classified according to the size of particles, sorting, and distribution of particles, or chemical content of silica, feldspar, and calcite.

Grain Size. In the most commonly used classification system, the size of the particles determines the general rock name. For example, sand-sized particles for sandstones; pebbles form conglomerates, and so on. The rack names are shown in the table below along with their component particle sizes. The divisions in the classification are based upon the Modified Wentworth scale used to measure grain size.

Grain Size Scale (Modified Wentworth Scale)

Diameter (in)	Particle	Sediment	Rock
< 0.0002	Clay	Mud	Claystone, mudstone, shale
0.0002 to 0.002	Silt		Siltstone
0.002 to 0.08	Sand	Sand	Sandstone
0.08 to 2.5	Pebble	Gravel	Conglomerate (rounded)
2.5 to 11.8	Cobble		
> 11.8	Boulder		Breccia (angular)

Conglomerates and breccias have adjectives such as *clast-supported and matrix supported*. *Clast-supported* means that he clasts are sorted well enough so that the large clasts touch, and *matrix-supported* is not.

A well-sorted sandstone is called an arenite. A poorly sorted sandstone with a matrix of silt and clay is called a wacke. A sandstone with more than 25% feldspar is an arkose. And, if lithic fragments or iron and magnesium minerals and feldspar are present along with quartz sand and silt, the rock is called a graywacke.

Sorting. Sedimentary rock names are further characterized by the sorting the particles have undergone. The distribution of grain sizes reflects the type of transport a sediment has experienced and the depositional environment. A well-sorted (or poorly graded) sediment has two or three sizes present. A poorly sorted (or well-graded) sediment has a wide range of grain sizes present.

Cementation. Cementing substances have usually been referred to by adjectives such as calcareous, dolomitic, and siliceous; however, these terms might also imply accessory detrital materials, so that the unambiguous terms calcite-cemented, dolomite-cemented, and quartz-cemented are recommended.

Chemical Rocks. Chemical rocks have been classified according to chemical composition, depositional texture, and depositional environment.

Common chemical rocks are limestone, dolomite, evaporites (gypsum, anhydrite, halite, etc.) phosphate rocks (apatite), manganese nodules, ironstones (limonite, siderite, and chlorite silicates), coal, pyrite, chert, and diatomite, and some cherts have a biogenic component to their formation.

Igneous Rock Classification.

Classification of igneous rocks is based upon the mineral content of the rock. Minerals upon which the classification is based are feldspar, quartz (or feldspathoids), and mafic minerals such as biotite, hornblende, pyroxene, and olivine. Of these minerals, identifying feldspar is the key to classification.

The International Union of Geological Sciences (IUGS), Sub commission on the Systematics of Igneous Rocks attempted to create a universal classification of igneous rocks. The committee's recommendations for plutonic and volcanic rocks are shown in the following two tables, respectively. A rock is classified by determining it composition relative to the percentage of alkali feldspar, plagioclase, and quartz (or feldspathoid).

Modal Classification of Plutonic Igneous Rocks

Modal Values	**Classification**
Q > 60	Not igneous
Q = 20-60, P <10	Alkali feldspar granite
Q = 20-60, P = 10-65	Granite
Q = 20-60, P = 65-90	Granodiorite
Q = 20-60, P >90	Tonalite
Q = 5-20, P <10	Alkali feldspar quartz syenite
Q = 5-20, P = 10-35	Quartz syenite
Q = 5-20, P = 35-65	Quartz monzonite
Q = 5-20, P = 65-90	Quartz monzodiorite (An < 50), Quartz monzogabbro (An > 50), Quartz anorthosite (M < 10)
Q = 5-20, P >90	Quartz diorite (An < 50), Quartz gabbro (An > 50), Quartz anorthosite (M < 10)
Q = 0-5, P <10	Alkali feldspar syentie
Q = 0-5, P = 10-35	Syenite
Q = 0-5, P = 35-65	Monzonite
Q = 0-5, P = 65-90	Monzodiorite (An < 50), Monzogabbro (An > 50), Anorthosite (M < 10)
Q = 0-5, P >90	Diorite (An < 50), Gabbro (An > 50), Anorthosite (M < 10)
F = 0-10, P <10	Foid-bearing alkali feldspar quartz syenite
F = 0-10, P = 10-35	Foid-bearing syenite
F = 0-10, P = 35-65	Foid-bearing monzonite
F = 0-10, P = 65-90	Foid-bearing monzodiorite (An < 50), Foid-bearing monzogabbro (An > 50)
F = 0-10, P >90	Foid-bearing diorite (An < 50), Foid-bearing gabbro (An > 50)
F = 10-60, P <10	Foid syenite
F = 10-60, P = 10-50	Foid monzosyenite
F = 10-60, P = 50-90	Foid monzodiorite (An < 50) Foid monzogabbro (An > 50)
F = 10-60, P >90	Foid diorite (An < 50), Foid gabbro (An > 50)
F > 60	Foidolites

Q = quartz/(quartz = alkali feldspar = plagioclase)
F = feldspathoids/(feldspathoids = alkali feldspar)
P = feldspathoids/(feldspathoids = plagioclase feldspar)
M = color index
An = % anorthite inplagioclase

Modal Classification of Volcanic Igneous Rocks

Modal Values	Classification
Q > 60	Not igneous
Q = 20-60, P <10	Alkali feldspar rhyolite
Q = 20-60, P = 10-65	Rhyolite
Q = 20-60, P = 65-90	Dacite
Q = 20-60, P >90	Dacite
Q = 5-20, P <10	Alkali feldspar quartz trachyte
Q = 5-20, P = 10-35	Quartz trachyte
Q = 5-20, P = 35-65	Quartz latite
Q = 5-20, P = 65-90	In all six fields, the names andesite and basalt are applied; basalt is used if SiO_2 < 52wt % after H_2O and CO_2 are deleted and the analysis recalculated to sum 100%
Q = 5-20, P >90	
Q = 0-5, P = 65-90	
Q = 0-5, P >90	
F = 0-10, P = 65-90	
F = 0-10, P >90	
Q = 0-5, P <10	Alkali feldspar trachyte
Q = 0-5, P = 10-35	Trachyte
Q = 0-5, P = 35-65	Latite
F = 0-10, P <10	Foid-bearing alkali feldspar quartz trachyte
F = 0-10, P = 10-35	Foid-bearing trachyte
F = 0-10, P = 35-65	Foid-bearing latite
F = 10-60, P <10	Phonolite
F = 10-60, P = 10-50	Tephritic phonolite
F = 10-60, P = 50-90	Phonolitic tephrite
F = 10-60, P > 90	Tephrite (olivine < 10%) Basanite (olivine > 10%)
F > 60	Foidite

Q = quartz
P = feldspathoids/(feldspathoids = plagioclase feldspar)
F = feldspathoids/(feldspathoids = alkali feldspar)

***Metamorphic Rock Classification*.**

In this binomial system for naming metamorphic rocks, the main rock name is based on the texture of the rock, and the principal or more significant minerals are added as modifying nouns, as in biotite-quartz schist or andalusite-cordierite hornfels. The names are meant to be applied on a descriptive basis; a schistose rock, for example, should not be called a hornfels just because it is found in a contact aureole.

Textures.

- Schistose – grains platy or elongate and oriented parallel or subparallel. *Foliated* (lepidoblasitc) of fabric is planar, *lineated* (nematoblastic) if linear.
- Granobalstic – grains approximately equidimensional; platy and linear grains oriented randomly or so subordinate that foliation is not developed.
- Hornfelsic – grains irregular and interincluded but generally microscopic; recognized in field by unusual toughness, ring to hammer blow, and hackly fracture at all angles. Under hand lens, freshly broken surfaces show a sugary coating that will not rub off (formed by rending of interlocking grains).
- Semischistose (gneissic) – platy or linear grains subparallel but so subordinate or so unevenly distributed that rock has only a crude folliation; especially common in metamorphosed granular rocks, such as sandstones and igneous rocks.
- Cataclastic – clastic textures resulting from breaking and grinding with little if any recrystallization; characterized by angular, lensoid, or rounded fragments (porphyroclasts) in a fine-grained and commonly streaked or layered
- Groundmass. *Mortar structure* applies to nonorientated arrangements, and *phacoidal*, *flaser*, and *augen structure* apply to lenticular arrangements.

Rock Names.

Schistose Rocks.

- Schist – grains can be seen without using a microscope.
- Phyllite – all (or almost all) grains of groundmass are microscopic, but cleavage have sheen caused by reflections from platy or linear minerals; commonly corrugated.
- Slate – grains are microscopic; very cleavable; surface dull; tougher than shale and cleavage commonly oblique to bedding.
- Phyllonite – appearance like phyllite but formed by cataclasis (see mylonite) and recrystallization commonly of coarser-grained rocks, as indicated by relict rock slices, slip folds, and prophyroclasts.

Granoblastic Rocks.

- Granulite or Granofels – granoblastic rocks, irrespective of mineral composition; because granulite can connote special compositions and conditions or origin, granofels may be preferred.
- Quartzite, marble, and amphibolite – compositional names that generally connote granoblastic texture; exceptions should be modified for clarity, as schistose quartzite or plagioclase hornblende schist.
- Tactite (skarn) – heterogeneous calc-sillicate granulites and related metasomatic rocks of typically uneven grain.

Hornfelsic Rocks.

- All called hornfels, or, if relict features are clear, hornfelsic may be used with the original rock name (as hornfelsic andesite)

Semi-schistose (Gneissic) Rocks.

- Semi-schist – fine-grained (typically less than 1.4 mm) so that individual platy or lineate grains are indistinct; relict features often common.
- Gneiss – generally coarser than ½ mm with small aggregates of platy or lineate grains forming separate lenses, bladed, or streaks in otherwise granoblastic rock. Platy or lineate structures may be distributed evenly through the rock or may be concentrated locally so that some layers or lenses are granoblastic or schistose (banded gneiss).

Cataclastic Rocks. Where original nature of rock is still apparent, rock name can be modified by suitable adjectives (as cataclastic granite, flaser gabbro, phacoidal rhyollite).

- Mylonite – crushing so thorough that rock is largely aphanitic and commonly dark-colored; may be layered and crudely folliated but not schistose like phyllonite; porphyroclasts commonly rounded or lenticular.
- Ultrmylonite, pseudotachyylyte – aphanitic to nearly vitreous-appearing dark rock commonly injected as dikes into adjoining rocks.

Relict and Special Textures and Structures. If textures of low-grade metamorphic rocks are dominantly relict, original rock names may be modified (as massive metabasalt, semischistose met-andesite). If hydrothermal alteration has produces prominent new minerals, names such as chloritized diorite and sercitized granite can be used.

- Strongly metasomatized rocks with coarse or unusual textures may require special names such as gneissen, quartz-schorl rock, and corundum-mica rock.
- Magmatite – a composite rock composed of igneous or igneous-appearing and/or metamorphic materials that are generally distinguishable megascopically.

7.0 REFERENCES

American Society for Testing and Materials (ASTM), 1990, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), ASTM Standard D-2488-90.

Dunn, I.S., Anderson, L.R. and Kiefer, F.W., 1980, Fundamentals for Geotechnical Analysis, John-Wiley, New York.

Compton, Robert R., 1985, Geology In The Field, John Wiley & Sons, New York.

Osiecki, P. and Dirth, L., 1996, RG Exam Study Guide.

International Union of Geological Sciences (IUGS) Sub commission on the Systematics of Igneous Rocks, 1973, "Plutonic rocks, classification and nomenclature," *Geotimes*, 18, no. 10, pg. 26-30.

U.S. Bureau of Reclamation, Geotechnical Branch, 1986, Visual Classification of Soils, Unified Soil Classification System, Denver, Colorado.

8.0 ATTACHMENTS

Attachment A - Checklist for the Description of Fine-Grained Soils

Attachment B - Checklist for the Description of Coarse-Grained Soils

ATTACHMENTS

Attachment A

Checklist for Description of Fine-grained and Organic Soils

Items of descriptive data	Typical information desired for silt and clay
Group name	SILT, LEAN CLAY, ETC., include cobbles and boulders in typical name when applicable.
Size distribution	Approximate percent of fines, sand, and gravel of fraction less than 3 inch in size; must add to 100 percent
Plasticity of fines	Nonplastic; low; medium; high
Dry strength	None; low; medium; high; very high
Dilatancy	None; slow; rapid
Toughness near plastic limit	Low; medium; high
Moisture condition	Dry; moist; wet
Color	Munsell color chart; if possible, note mottling or banding
Odor	Only mention of organic or related to contaminants
Structure	Stratified; laminated; fissured; slickensided; blocky; lensed; homogeneous
Consistency	Very soft; soft; firm; hard; very hard
Relative Permeability	Low; medium; high; fractures, open, iron-stand, calcite-filled, open but claylined
Local Geologic Name	If applicable
Group symbol	CL, CH, ML, MH, OL/OH, or appropriate borderline symbol when applicable; should be compatible with typical name used above

Attachment B

Checklist for Description of Coarse-grained Soils

Items of descriptive data	Typical information desired for sand and gravel
Group name	WELL-GRADED GRAVEL WITH SAND, ETC., will include cobbles and boulders in typical name when applicable.
Gradation	Describe range of particle sizes, such as fine to medium sand or fine to coarse gravel, or the predominant size or sizes as coarse, medium. Fine sand or coarse or fine gravel.
Size distribution	Approximate percent of gravel, sand, and fines in the fraction finer than 3 inch; must add to 100 percent.
Plasticity of fines	Nonplastic; low; medium; high
Particle shape	Flat, elongated, or flat and elongated (if applicable)
Particle angularity	Angular; subangular; subrounded; rounded
Moisture condition	Dry; moist; wet
Color	Munsell color chart
Odor	Only mention of organic or related to contaminants
Structure	Stratified; lensed; homogeneous
Cementation	Weak; moderate; strong
Relative Permeability	Low; medium; high; fractures, open, iron-stained, calcite-filled, open but claylined
Local Geologic Name	If applicable
Group symbol	GP, GW, SP, SW, GM, GC, SM, SC, or the appropriate symbol when applicable; should be compatible with typical name used above
Mineralogy	Rock hardness for gravel and coarse sand. Note presence of mica flakes, shaly particles, or organic matter.

SOP-13
Soil Excavation

Yerington Mine Site
Standard Operating Procedure

Revision 0
Revision Date: June 6, 2006

SOP-13
SOIL EXCAVATION

TABLE OF CONTENTS

1.0 OBJECTIVE

The objective of this standard operating procedure (SOP) is to establish consistent methods for conducting soil excavations for the purposes of:

- Interim remedial action which may be necessary to lessen immediate impacts of a contaminant to receptors or to control the spread of contamination;
- A final remedy for site mitigation; and
- In some instances, determining the extent of impacted soil through trenching or potholing.

Interim remedial action can occur any time during an environmental investigation with concurrence from applicable regulatory agency(s).

2.0 DEFINITIONS

Cave-in. The separation of a mass of soil or rock material from the side of an excavation, or the loss of soil from under a trench shield or support system, and its sudden movement into the excavation, either by falling or sliding, in sufficient quantity so that it could entrap, bury, or otherwise injure and immobilize a person.

Excavation. Any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal.

Face or sidewall. The vertical or inclined earth surfaces formed as a result of excavation work.

Failure. The breakage, displacement, or permanent deformation of a structural member or connection so as to reduce its structural integrity and its supportive capabilities.

Hazardous atmosphere. An atmosphere which by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen deficient, toxic, or otherwise harmful, may cause death, illness, or injury.

Kickout. The accidental release or failure of a cross brace.

Protective system. A method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures. Protective systems include support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.

Ramp. An inclined walking or working surface that is used to gain access to one point from another, and is constructed from earth or from structural materials such as steel or wood.

Sheeting. The members of a shoring system that retain the earth in position and in turn are supported by other members of the shoring system

Shoring (Shoring system). A structure such as a metal hydraulic, mechanical, or timber shoring system that supports the sides of an excavation and which is designed to prevent cave-ins.

Trench (Trench excavation). A narrow excavation (in relation to its length) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet. If forms or other structures are installed or constructed in an excavation so as to reduce the dimension measured from the forms or structure to the side of the excavation to 15 feet or less, (measured at the bottom of the excavation), the excavation is also considered to be a trench.

3.0 APPLICABILITY

This general procedure will be used in planning and implementing soil excavation projects. These procedures are subject to modification to accommodate differing methodology employed by different excavation subcontractors, or client-specific requirements and requirements identified in site-specific work plans and Field Sampling Plan (FSP).

These procedures are general minimum standards. With concurrence from BC's Quality Manager, these procedures may be modified or supplemented for a specific project by site-specific workplans or health and safety plans.

4.0 RESPONSIBILITY

The *Project Manager*, or designee, will have the responsibility to oversee and ensure that these soil excavation procedures are implemented in accordance with this SOP and any site-specific planning documents such as a workplan, remedial action plan (RAP), field sampling plan (FSP), quality assurance project plan (QAPP), and site-specific health and safety plan (HSP).

The *field personnel* will be responsible for the understanding and implementation of this SOP and related SOPs during all field activities, as well as, obtaining the appropriate field logbooks, forms and records necessary to complete the field activities.

5.0 REQUIRED MATERIALS

The equipment and supplies required for field personnel for this SOP include the following:

- White spray paint or other materials such as stakes, concrete nails, flagging, etc., to mark the excavation limits;
- Traffic cones and barrier tape to delineate work area;
- Field notebook;
- FID or PID or equivalent direct reading instrument; and
- Personnel Protective Equipment (PPE) as specified in the SHSP.

6.0 METHODS

Planning and implementation of soil excavation work for the purposes described above is comprised of four (4) general steps:

1) Excavation Design;
2) Pre-field Activities (subsurface clearance/permits);
3) Establishment of Site Controls;
4) Soil Excavation.

In addition several other steps are often part of soil excavation work, including confirmation sampling, waste Characterization, and site restoration.

6.1 Excavation Design

Design of a trenching or excavation project associated with potentially hazardous materials will be determined by the objective(s) of the work, the site specific geology and hydrogeology, contaminant characteristics, suspected source, and regulatory requirements. The excavation design should account for each of these criteria by specifying work items such as shoring requirements, dewatering requirements, stockpile management, and air monitoring requirements. Baseline drawings of the site should be prepared to allow for the preparation of demolition and remediation plans. Accurate drawings are also required for the specification packages used to procure and manage demolition and remediation contractors. At a minimum, the drawing(s) should show the site structures, site boundaries, areas to be protected (i.e., survey benchmarks, wells, and any site feature to remain undisturbed), and utilities and termination points.

Utility locations and termination points must be determined early in the planning process to avoid delays associated with utility disconnection and the removal of utility-owned equipment. Representatives of the local water district, gas & electric company, and telephone should be consulted to determine their needs for utility disconnection and equipment removal. Furthermore, early coordination with the utility companies will ensure that utility disconnection activities are properly scheduled and specified to avoid construction delays. Water service should remain intact to provide fire protection and construction water until demolition and soil mitigation is complete.

6.2 Pre-Field Activities

Prior to implementation of any excavation project, all applicable permits and notifications shall be submitted and approved. Besides approval from oversight agencies, permits or notifications may be required with the following agencies:

- City Building & Planning Departments
- Air Pollution Control Districts

- Local Fire & Safety Departments
- Regional Water Quality Control Boards or Wastewater Departments (in the case of dewatering activity)

A Public Notification Program and/or Community Health and Safety Plan may be required by the oversight agency.

It is essential that the excavation areas be cleared for utility and other subsurface obstructions. At a minimum, current facility drawings shall be obtained, and in some cases written sign-off by a responsible person from the facility shall be obtained. Be aware that these records may not be accurate. The obstructions revealed by facility drawings should be physically located, and either removed or protected from damage. In addition, Underground Service Alert (U.S.A.) or equivalent utility search service shall be notified in accordance with local regulations. In Nevada, it is required to mark the digging location in white paint and to notify U.S.A. a minimum of 48 hours in advance of digging.

6.3 Establishment of Site Controls

Mobilization activities should include the establishment of site controls needed for excavation activities and may include some or all of the following tasks:

- Establishment of site control measures including temporary fencing to secure the site and equipment/materials storage area, site access/egress points, signs and barricades for on-site traffic control and warning tape for prohibited areas (i.e., the contaminated soil excavation, treatment and stockpile areas);
- Mobilization of office trailers, equipment trailers, equipment/materials storage area and connect to temporary utilities and communication lines (phone and fax);
- Establishment of a water distribution system from existing water lines/fire hydrants, irrigation system to critical work areas;
- Establishment of equipment/personnel decontamination areas and work zones; and
- For long term projects, provide sanitary facilities for site workers and visitors.

6.4 Soil Excavation

The excavation process is generally conducted using conventional earth moving equipment such as excavators, front-end loaders, and dump trucks. The remediation subcontractor chosen for any excavation work involving hazardous or non-hazardous waste remediation or investigation projects in Nevada shall, at a minimum, maintain to following contractors licenses:

<u>Class A – General Engineering Contractor</u>. A general engineering contractor is a contractor whose principal contracting business is in connection with fixed works requiring specialized engineering knowledge and skill.

C-12 – Earthwork and Paving. An earthwork and paving contractor digs, moves, and places material forming the surface of the earth, other than water, in such a manner that a cut, fill, excavation, grade, trench, backfill, or tunnel (if incidental thereto) can be executed, including the use of explosives for these purposes. This classification includes the mixing, fabricating and placing of paving and any other surfacing materials.

HAZ – Hazardous Substance Removal. No contractor shall engage in a removal or remedial action unless the qualifier for the license has passed an approved hazardous substance certification examination.

OSHA Excavation Safety Standards must be followed for during excavation work in Nevada. General Requirements for excavations include requirements for surface encumbrances, UST removals and installations, exposure to falling loads, warning system for mobile equipment, hazardous atmospheres[1], and protection from hazards associated with water accumulations.

Shoring/Sloping Requirements. If for any reason, subcontractors, clients, agency representatives, or BC personnel enter the trench or excavation, shoring or sloping is required if there is any doubt about the soil stability or if any of the following conditions apply:

1. **Depth of trench.** If the trench is five (5) feet deep or more (if there is a possibility of soil movement, even shallower trenches should be shored).
2. **Soil Classification.** The more liquid the soil, the more you need to protect yourself against cave-in.
3. **Changing weather conditions.** Trenches or excavations which are safely sloped or shored in dry weather can become unstable from changing weather conditions (e.g., hardpacked soil can quickly become soupy and unstable after rain and thawing soil can also become unstable).
4. **Heavy loads in area.** Heavy equipment next to a trench. Nearby structures such as buildings, curbs, trees and utility poles exert stress on trenches and excavations.
5. **Vibration.** If digging a trench near a roadway or where other operations create vibration, make certain the shoring/sloping design reflects these conditions.

Stockpile Management. In general, there are four criteria for segregation of soil and debris (consult the workplan):

- Debris and rubble (i.e., bricks, concrete, asphalt, cobbles, boulders, and timbers) suitable for disposal as non-hazardous waste;
- Contaminated debris and rubble that is inappropriate for replacement should be stockpiled separately or put in holding bins for treatment and off-site disposal;

[1] Every trench is a possible trap for hazardous atmospheres.

- Excavated overburden and soils that test below project cleanup goals should be left in place, or used as backfill material; and
- Soils that are above cleanup levels should be stockpiled separately for treatment or offsite disposal.

Soil stockpiles containing contaminants, particularly VOCs, shall be sprayed regularly with water to minimize dust and/or vapor emissions during stockpiling activities. Heavy plastic sheeting should be used to cover the stockpiles to provide additional dust and/or vapor control. The sheeting should be secured in place with sandbags or boulders. Surface water runoff resulting from rain must be diverted around the covered stockpiles to ensure that soil is contained within the stockpile perimeter. If the stockpile is placed in an area without concrete or asphalt surface cover, the stockpile should be placed on minimum 30-mil polyethylene film.

6.5 Other Aspects

Several other considerations often are examined and addressed in any site specific planning documents associated with soil excavation. While not every excavation project will include these aspects,. many often do include one or more. These other aspects to be considered include confirmation sampling, waste characterization, and site restoration. Details of these activities should be provided in the site specific planning documents. The Subsections below are meant to provide general guidance regarding these associated aspects of soil excavation projects.

6.5.1 Confirmation Sampling

During the excavation process, samples are often collected at the base and perimeter of the excavation and analyzed using appropriate analytical methods as described in the work plan. The purpose of such samples is to document whether an excavation has been completed, or to document the degree to which removal occurred. In some cases confirmation sampling is done with a mobile laboratory providing real-time results for field decision making based on cleanup goals as defined in the project specific planning documents. In other cases a pre-determined area and depth of soil is defined, and not exceeded in the field.

In the first case above, if analyte concentrations exceed cleanup levels in any sidewall or base sample, the excavation process would continue in that direction to remove the additional soil. This sampling process is generally repeated until all the soil with constituent concentrations greater than action levels is removed or as specified in the work plan.

The samples should be collected either directly from the excavation floor and sidewalls or from the excavator bucket when raised from the excavation floor or sidewall sampling location. Sampling, Quality Assurance/Quality Control procedures for excavated soil will follow the Soil Sampling SOP.

Field Quality Assurance/Quality Control Samples. Quality Assurance/Quality Control samples shall be collected and analyzed to establish support of the analytical data. The work plan or project QAPP will specify the number and/or frequency of the QA/QC samples. At a minimum, equipment blanks, and for volatile organic (VOC) analysis, trip blanks (for off-site analysis) shall be included in the QA/QC sample set.

Record Keeping. Observations made during field operations will be recorded daily on field forms and in bound field notebooks to produce a permanent record of all the field activities. Field documentation shall be in accordance with BC's SOP for Field Notes and Documentation. In addition, soil sample locations will be plotted on excavation drawings. These drawings will be modified as needed to reflect the full dimensions of the excavation with regard to area and depth. Mobile laboratory results will also be plotted on excavation drawings as data became available. Other information to be documented that is specific to the soil excavation or trenching projects includes:

- Soil type and sidewall observations;
- Trench and/or excavation measurements;
- Measured sample locations to the nearest vertical and lateral location to within 1 foot and identification;
- Surface encumbrances;
- Potentially dangerous atmospheric conditions;
- Protective systems (i.e., shoring, sloping, etc.);
- Utility protection (Gas, Water, Sewer, Electric); and
- Confirmation sampling methods

A competent person must make a daily inspection of the trench and protective systems as the work progresses. Competent person is defined as one who must demonstrate:

- Knowledge of the new provisions pertaining to excavations, trenches and earthwork;
- Knowledge of soil analysis as required in the new provisions pertaining to excavations, trenches and earthwork;
- Knowledge of the use of protective systems;
- Authority to take prompt corrective action on the job as conditions warrant; and
- Ability to recognize and test for hazardous atmospheres.

6.5.2 Waste Characterization

Another aspect of soil excavation that is often but not always part of an excavation project is defining the characteristics of the investigation derived waste. Usually waste from excavation projects is stored as a stockpile on site, until final disposition can be determined. Any stockpile sampling required by the site specific planning documents should be performed per Chapter 9, Part III of the United States Environmental Protection Agency (USEPA) SW-846 guidelines. SW-846 provides guidance for the development and implementation of a scientifically credible sampling plan. The site-specific planning documents should provide details for the quantity and analysis of samples collected from soil stockpiles.2

6.5.3 Site Restoration

Often, but not always, the final aspect of a excavation project includes site restoration. Site restoration usually follows confirmation sampling and analysis. If site restoration is required, imported soil, and if suitable for compaction requirements, excavated overburden and soils that tested below project cleanup goals can be placed into the excavation. The soil should be replaced in one-foot lifts and compacted using a vibratory sheepsfoot roller or comparable compaction device. The excavation should be brought to rough grade at a minimum compaction of 90 percent. Soil compaction testing should be conducted and a report prepared by a qualified geotechnical firm.

Site improvements such as asphalt drives, walkways, planter curbs, drive curbs, and crash posts may also be required as part of site restoration and may be restored to original condition depending on the proposed future use of the property. Photo documentation should be conducted upon completion of site restoration activities.

7.0 REFERENCES

United States Environmental Protection Agency (USEPA), 1997. SW-846 Update III, Chapter 9, Part III.

Rast, R.R., 1997. Environmental Remediation Estimating Methods, R.S. Means Company, Inc., Kingston, MA, 594 p.

8.0 ATTACHMENTS

None

[2] Sampling frequency and analysis of soil stockpiles may also be dictated by the chosen disposal facility.

SOP-14
Utility Clearance

Yerington Mine Site
Standard Operating Procedure

Revision 0
Revision Date: June 6, 2006

SOP-14
UTILITY CLEARANCE

TABLE OF CONTENTS

1.0 OBJECTIVES

The objective of this standard operating procedure (SOP) is to describe procedures to reduce the risk of contact with buried or above ground utility service lines. Reducing this risk is extremely important for worker health and safety and company liability.

2.0 APPLICABILITY

This SOP applies to all field activities where there is possible contact with above ground utilities or sub-surface utilities. The definition and location of subsurface and overhead utilities presents a major hazard to field personnel working on site. This SOP should always be implemented completely, and should be supplemented (or superseded, if necessary) only if the added requirements do not prevent adequate evaluation of utilities.

RESPONSIBILITIES

The *Project Manager*, or designee, will have the responsibility to oversee full compliance of this SOP. The Field Supervisor shall implement and document that this SOP was implemented on site.

The *Site Health and Safety Officer* shall ensure full compliance with the SOP and report any deficiencies to the Health and Safety Manager and the PM.

The *field sampling personnel* will be responsible for understanding and implementing this SOP during all field activities, as well as, obtaining the appropriate field logbooks, field records, instruments, materials and calibration standards necessary to complete the field task.

3.0 DEFINITIONS

Kilovolt (kv) is one thousand volts

4.0 REQUIRED MATERIALS

The materials required for this SOP include the following:

- Bound field logbook;
- Black or blue water proof and/or indelible ink pens;
- Instruments designed for locating subsurface utilities (subcontractor supplied);
- Maps/figures/drawings showing the location of known utilities; and
- Replacement batteries and parts for instruments (if applicable).

Instruments used during field activities may include, but are not limited to, the following:

- Utility Line Locating Devices
- Electromagnetic Instruments
- Magnetometers
- Ground Penetrating Radar

5.0 METHODS

This SOP provides a description of methods that are applied to establishing and clearing locations for subsurface investigations by locating utilities. Most often, other parties with experience in locating subsurface utilities conduct this activity. However, site field personnel oversee such operations and clearly have a responsible role in understanding when the job has been completed. These other parties are discussed further below.

Buried and overhead utilities must be identified and located prior to beginning any invasive field work. A several fold process is used to accomplish a good understanding of utilities in an area. This process is intended to be iterative and overlapping, and is then supplemented later by additional safety precautions to prevent the hitting of utilities. The process includes a pre-work identification of utilities, a notification to local utilities, a technical investigation of potential utilities, followed by field truth testing. This process is discussed in more detail below.

At the beginning of a project, a review will be made of any available property maps, blue lines, or as-builts prior to site activities. This exercise often will result in an incomplete picture and should always be supplemented whenever possible with additional information. However, examining as-built maps, if available, always enhances an understanding of utility locations in the area of investigation.

During the project site walk, any discrepancies or new information regarding utility locations should be added to project maps. The site walk is a good time to review and confirm overhead utility lines.

After the above actions have occurred, the next action, and one that should always be taken even when on private land, is notification of potential subsurface activity to the local utility locator service (typically Underground Service Alert [USA]). The USA number for Nevada is:

Nevada USA: 1-800-227-2600

The Field Supervisor shall consult with USA at least 48 hours in advance of conducting subsurface field work. All drilling or subsurface locations should be clearly marked before calling USA. Suggested marking guidelines are included in Attachment B. USA will assign a “ticket” number to your site that will need to be recorded. This ticket number is valid for a limited time, but may be extended by contacting USA again. USA will notify utility representatives who will mark according to the utilities’ color scheme. If possible, the field supervisor or designee should meet with the utility personnel to make sure they understand where all utilities are located.

Because USA only clears directly around marked locations it is often necessary to take additional precautions to locate utility locations throughout the area. If necessary, utilities may be located using standard geophysical methods such as electromagnetic (EM), ground penetrating radar (GPR), magnetic gradient survey and/or a pipe locator. A geophysical Subcontractor typically conducts these operations.

Another source of information, especially for private land, is the landowner. Landowners usually know, in general, where utilities are buried on their property.

Utility locations will be marked using the following color code, unless the facility locator uses a different color code:

COLOR	IDENTIFICATION
White	Work location
Red	Electrical lines
Yellow	Gas or oil lines
Orange	Telephone lines
Blue	Water lines
Green	Sewer lines

In addition to the above-described utility locating methods, field truth testing will be conducted to avoid inadvertently hitting a utility. Field truth testing usually means small bore holes will be hand augured to approximately five feet for all locations within developed areas where there is a potential to impact buried utilities. The hole must be reamed by hand to at least the diameter of the drill rig auger or bit prior to drilling. For soil gas surveys, the survey probe shall be placed as close as possible to the hand auger.

Methods for utility clearance for horizontal and slant boring will be determined by the PM and Health and Safety Manager if and when these conditions apply.

Special requirements are needed at each location where trenching or excavating will occur using a backhoe or other heavy equipment. Prior to ground-breaking, the soil must be probed with a magnetometer and/or a pole made of non-conductive material. Once an excavation is open, all uncovered utilities must be supported. Any repairs or modifications to existing utility lines require the line to be locked-out/tagged-out prior to work.

Also important to operations that will occur in areas with utilities is clearance of overhead lines. Drill rig towers can be high enough to directly contact or provide inadvertent grounds for overhead lines. The following table gives the required minimum clearances for working proximity to overhead power lines.

Nominal Voltage	Minimum Clearance
0-50 KV	10 ft., or one mast length; whichever is greater
>50 KV	10 ft., plus an additional 4 inches for every 10 KV over 50 KV or 1.5 mast lengths; whichever is greater.

If it is necessary to work without the minimum clearance, the overhead line must be de-energized or rerouted by the utility company or a competent electrical contractor. Any work of this nature must be completed with adequate lock-out/tag-out procedures as outlined in a project health and safety plan.

Utility Clearance Form (Attachment A) must be completed and signed off by the Field Supervisor prior to commencement of relevant site work. This form signifies that the Field Supervisor has observed, or designated that someone observed that all utility location aspects as outlined in this SOP have been completed.

Any deviations from this SOP must be approved by the PM after collaboration with Health and Safety Manager. Approval via telephone is acceptable in the event the PM is not on site.

When repairing existing utilities, that have been damaged, refer to the Health and Safety Plan Lock-Out and Tag-Out Procedure.

6.0 QUALITY ASSURANCE/QUALITY CONTROL

Quality Assurance/Quality Control with utility location is conducted through a project with tiered overlapping aspects that provide double checks of previous parts.

- The *first tier* is researching potential utility locations through as-built drawings.
- The *second tier* is through contacting USA (if available in your area), and hiring geophysical subcontractors experienced in locating utilities.
- The *third tier* is to ground truth test through advancing bore holes.

7.0 CORRECTIVE ACTIONS

Even using the best preventative approach as described above can fail to locate a utility, or result in a utility being hit during field activities. As a result, corrective actions need to be planned in advance, because of the serious health and safety and legal and financial liabilities associated with an accident. Health and safety aspects and emergency procedures should be outlined in a project specific safety plan. Prior to beginning field work, emergency phone numbers for all utilities should be obtained in the event a line is hit. In most cases, this may be a single number such as USA. In addition, identify Subcontractors or personnel that can make immediate repair to a broken utility. Quickly mobilizing such companies to a site can prevent costly breaks in utility lines.

8.0 REFERENCES

OSHA 1926.650 - 1926.652 *Excavations*

OSHA 1926.955 *Provisions for Preventing Accident Due to Proximity to Overhead Lines*

OSHA 1910-333 *Selection and Use of Work Practices in Sub-part S – Electrical*

9.0 ATTACHMENTS

Attachment A: Example Utility Clearance Form

Attachment B: Suggested Marking Guidelines

ATTACHMENT A

EXAMPLE UTILITY CLEARANCE FORM

UTILITY CLEARANCE FORM

Project: ____ Completed by: _____________________

Location: ______________________________________ Date: ____________________________

		Circle One		
1.	Review of Existing Maps	Yes	No	N/A
2.	Above ground utilities			
	a) marked on site maps	Yes	No	N/A
	b) necessary to lockout	Yes	No	N/A
	c) document procedures used to lock out or re-route	Yes	No	N/A
3.	Underground Utilities			
	a) State Agency called by: ____________________________	Yes	No	N/A
	Date: _____________ Ticket Number: _________________			
	b) Geophysical clearance method(s) used	Yes	No	N/A
	By: _________________________________Date: ____________			
	c) Utilities marked on site map (attached)	Yes	No	N/A
	By: _________________________________Date: ____________			
4.	Hand augering completed to _______ feet	Yes	No	N/A
	By whom: _______________________________Date: ____________			
5.	Trench/excavation probed	Yes	No	N/A

6. Approval:

____ _______________

Site Manager Date

____ _______________

Client Rep Date

7. Deviations from SOP Approval:

____ _______________

Project Manager Date

____ _______________

Health and Safety Manager Date

ATTACHMENT B

SUGGESTED MARKING GUIDELINES